Knowledge & Scientific News

A MONTHLY JOURNAL OF SCIENCE.

Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., F.R.Met.S., and E. S. GREW, M.A.

VOL. VI. No. 10. [NEW SERIES.] OCTOBER, 1909. [Entered at Stationers' Hall.] ONE SHILLING NET.

Shellac and the Lac Insect.

By G. CLARKE NUTTALL, B.Sc.

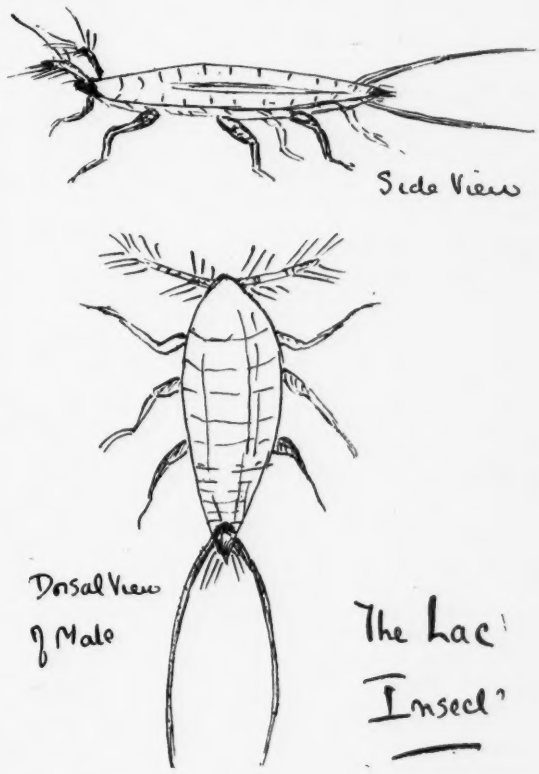
SHELLAC or lac is one of those aids to civilisation about which there has tended to be an atmosphere of mystery and romance.

Already familiar to us in the form of sealing wax, varnish, furniture polish, hat-stiffening, and the like, and, of course, in the decoration of every conceivable thing hailing from India—trays, boxes, tables, beds, shields, and a hundred and one other things—it is, nevertheless, quickly rising now into vastly greater importance because it has been found essential in electrical work (whose immense development has been of such mushroom growth the past few years), and because, too, it is largely required in the preparation of gramophone records. Hence the exports from India have quadrupled, and in 1905 no less than 6,000 tons of it were imported into the United States alone.

Now the lac industry is of great antiquity. Thousands of years ago, in prehistoric times, the natives knew its value and used it largely. There are various references in Sanskrit literature to the lac tree, that is, to the palas or dhak. In 1590 the great Akbar wrote full particulars as to how lac resin should be used in varnishing the wood of public buildings. The first European who described it was a Dutchman who was sent on a scientific mission to India in the 16th century by the King of Portugal. He published his knowledge of its use and value in 1596—a translation was soon after made in England—but he had no idea whatever of the true origin of the wonderful resin. Since that time, it is true, we have learnt much about it, but with this sudden leap in value and importance there has now come a great accession to our knowledge.

Last year, in an admirable treatise, the Forestry Department of the Government of India, through Mr. Stebbing, enabled us, perhaps for the first time, to obtain a perfectly definite and clear idea of its origin, nature, and manipulation, and of the life history of the insect to which it owes its existence. For shellac, or lac as it is generally termed in the initial stages, is a product of the animal kingdom, and may be defined as a resinous excretion by a scale-insect known as Tachardia lacca, a close relative of bugs, plant lice, and the like, and a native of India. It lives upon many varying native trees, though the kusam (*Schleichera trijuga*), the dhak (*Butea frondosa*), the pipal (*Ficus religiosa*), and the arhardal (*Cajanus indicus*) are its favourites. It is also found, at times, upon the banyan (*Ficus bengalensis*) and upon the mango (*Mangifera indica*).

Great numbers of these insects dwell closely together upon the trees, and each proves to be nothing more or less than an animated miniature syphon. At the mouth of every one is a tiny lancet with which it pierces the tree, and through the opening thus made it inserts a sucking apparatus. Then it proceeds to draw up into itself the living sap of the tree; this passes through its body, is modified in the process, and passes out again at the other end in the form of lac. The lac accumulates and is gradually built up round the insect into a small, red, dome-shaped excrescence. Owing to the myriads of these excrescences they tend to run into one another and form a regular incrustation on the branches.



The life history of the insect may be summarised as follows, though it varies in detail in different parts of India:—About the beginning of July tiny red larvæ can be seen swarming out of the incrustations in countless numbers and spreading over the neighbouring twigs. Each is oblong in shape, with two minute eyes, two short antennæ or feelers, and six short legs. Curious tufts of white powdery hairs—the breathing apparatus—grow from each side of the thorax. This swarming goes on for two or three weeks, not all the insects appearing at the same time, but each, as it appears, immediately sets to work to find a suitable

position where it can set up as a "syphon" on its own account. Within twelve hours its fate is sealed, and during this time it takes no nourishment of any kind, as its whole attention is taken up with settling itself in life. A certain number will be successful, but a far larger number are doomed, owing to their not being able to bore through the cortex at the point they attempt it, and hence cannot get at the sap.

A successful insect, however, settles to work, and for about two and a half months goes on steadily forming lac incrustation, the female producing a bigger structure than the male. At the end of this time the males creep out backwards from under the edge of their scales; they have grown a little since we saw them first as larvæ, and have now larger antennæ and four eyes instead of two (two more having appeared under the head), and they crawl over the twigs looking for the females and fertilising them. Then they die, their life work quite finished. The females go on forming lac for another two and a half months and developing too; then for a month, the last month of their lives, they rest dormant, taking no nourishment, lying inert. The eggs hatch out within them, perhaps a thousand in number in each, and the larvæ emerge and swarm, trying to find new homes while the mothers shrivel and die.

There are thus two generations in every year, the second generation beginning to swarm in the early part of December and distinguished by the single fact that the males have wings.

Now, the lac insects have various enemies to contend with during their short life. Birds are on the outlook for the larvæ when they first swarm, and monkeys like the sweet-tasting lac and will eat it in considerable quantities and include the insects, too, in their meal. Ants are still greater pests to them, for though they do not deliberately eat up the insects themselves, yet they feed on the lac with avidity, and often injure the insects in so doing. Certain caterpillars, too, will prey upon the lac insect, and rain, frost, and hail are often injurious to large numbers.

Lac is almost invariably collected by natives, and the collection is made by breaking off the incrusted branches and twigs. These are sold as "sticklac" to middlemen who take them in large quantities to factories. Here they are broken up into short lengths and crushed either by hand or by machinery. This crushed matter is divided into three parts—(1) the wood, which is used up as fuel; (2) the dust—"khud"—sold to makers of bangles and toys; (3) the true granular lac which is known as seed lac. The next process is to wash the seed lac for twenty-four hours; the water which runs away from it is a deep purple colour and formed the once valued lac-dye, but is valuable no longer, as it has been supplanted by aniline dyes. Drying follows, the substance being spread out and finally bleached. At this stage it is often mixed either with resin to lower its melting point, or with opiment (yellow arsenic) to make it opaque, or with both substances at once. The mixture is then put into very long, narrow cloth bags, 10 to 12 feet long and 2 inches wide, and held over open fires. The worm-like bags are slowly twisted and the melting lac oozes and drops on to the floor. It is then stretched into thin sheets and sold as shellac. All fragments and parings are carefully secured throughout the whole manufacture; nothing is wasted, and these inferior qualities are sold as button-lac and garnet-lac.

Hitherto the cultivation and collection have been almost entirely in the hands of the natives, and hence the methods employed are of the original primitive character. But now shellac is becoming so valuable and the demand for it is increasing so fast that the Government of India is beginning to interest itself more closely in lac cultivation, and the Forest Department has been entrusted with the work of forming lac preserves. The matter has become more urgent during the past four years since the price began to rise, and prompt action is felt to be advisable. In 1896 the value of the export from Bengal was 1,38,55,770 R. In 1906 it was 3,14,82,409 R., and yet the actual difference in quantity exported was only between 204,072 cwts. in 1896 and 271,101 cwts. in 1906. The total export from India in 1906 was of the value 3,31,39,706 R.

It must be realised that all these facts concerning the life history of the insect are of the greatest importance. If the Government is to extend successfully the lac industry it must ascertain them before it can know the best time and methods of propagating the insect and the proper trees on which it can thrive. Many absolute failures in promoting lac cultivation in the past were entirely due to ignorance of these facts, as, for instance, mistaking the swarming of the male insects for the swarming of the larvæ. During the past two years considerable research and elucidation of the problems of lac cultivation has been done in India, and it is now suggested that the industry might be greatly furthered by forming forest villages inhabited by people who could do the little grain cultivation necessary for their own small needs and devote the rest of their time to such forest work as lac cultivation.

Finally, the summing up of the official report is interesting:—"It will have become abundantly evident that, with the exception of the Central Provinces, the Department has not realised the immense value of lac as a minor forest product. . . . The position has to be faced that the cultivation of the product on scientific lines is not understood. But little advance has been made in the production of the substance since the days of Akbar, and the daily increasing demand for the product of which India is the chief producer would seem to necessitate considerably more attention being paid to its collection than has been the case in the past. . . . There appears to be small reason to doubt that money expended on this work will yield very large returns."

School of Art Wood-Carving.

THE School of Art Wood-Carving, 39, Thurloe Place, South Kensington, has been re-opened after the usual summer vacation, and we are requested to state that some of the free studentships in the Evening Classes maintained by means of funds granted to the school by the London County Council are vacant. The day classes of the school are held from 10 to 1 and 2 to 5 on five days of the week, and from 10 to 1 on Saturdays. The evening class meets on three evenings a week and on Saturday afternoons. Forms of application for the free studentships and any further particulars relating to the school may be obtained from the manager.

STOKLAGA has published the results of experiments in inoculating soil with nitrogen-fixing bacteria, which possess great power of assimilating free nitrogen and are retarded in development by nitrates in the soil. The radio-bacteria, on the other hand, decompose nitrates, and liberate nitrogen, which is voraciously consumed by the azotobacteria. The results of the experiments show that inoculation with nitrogen-fixing bacteria increases the crop and improves its quality, provided that care is taken to supply the carbohydrates, potash, and phosphoric acid which these bacteria require for their growth, and to neutralise the free acids of the soil by applying lime in liberal quantities.—(*Scientific American.*)

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Photo, Seton P. Gordon.] **A Young Mountain Eagle.**

Photo, Seton P. Gordon.] **A Mountain Eagle — in deep thought.**

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The Mountain Eagle.

By ALEX. INKSON MCCONNOCHIE.

THE mountain eagle, *Aquila chrysaëtus*, is known to many as the golden eagle, but in the Highlands of Scotland, where that noble bird is so much at home, Iolair Dubh, the black eagle, is the Gaelic name. To the Celts it is also "the leader," or "he that showeth the way." Thanks to an improved public feeling and the solicitude of deer forest owners and lessees, the eagle is rapidly becoming numerous, so one now rarely reads an account of a climbing expedition among the higher mountains without some mention of "the emperor of the sky."

Two centuries ago eagles had become so numerous and destructive in the Highlands that district associations were formed to kill the birds and destroy their eggs, for the heavy toll of lambs, etc., was more than sheep farmers could bear. Records show that in 1714 twenty shillings (Scots) was the reward for each eagle killed, and yet a dozen years later they seem to have become even more plentiful, and so the reward was increased. Between 1776 and 1786 no fewer than seventy eagles were accounted for in Deeside, while in Sutherlandshire between 1831 and 1834 the numbers reached 171 old birds and 53 young and eggs. Seventy years ago, in spite of systematic persecution, the eagle had a much wider range in Scotland than to-day, for in 1835 we read of an eyrie on the Pentland Hills with two eaglets and an addled egg; the larder included two rabbits, a partridge, and a portion of a salmon. Sheep-farming, however, fell on evil times, and deer took their place, so once more the mountain eagle came into its own, and even received the protection of Parliament.

The situation of eyries is sometimes inexplicable. There seems a general disinclination to nest close to one another, yet two eyries have been seen in the same neighbourhood. In the one instance an old Scots fir was selected, in the other a practically inaccessible rock. We paid several visits to the former, and were much struck with the dirtiness of the eggs, owing to the claws of the eagles being often wet with blood after tearing up their prey. The nest was a considerable structure, about six feet in diameter, very rudely formed from rather big branches. The framework must have taken both time and pains to put into position; over it were placed smaller branches, while above all were little green twigs and grasses, with a few of the eagles' own downy feathers. Some few years previously the same pair built on another branch of the pine, but the added weight of the winter's snow broke the branch, so a new foundation had to be sought. Nor are all rock sites for eyries selected with discrimination, for while apparently unapproachable, one side may afford such easy access that one may (as the writer has done on Lochnagar) all but walk into the nest.

Deerstalkers and mountaineers have rarely any difficulty in locating an eagle's eyrie. Little watching of the birds is required before one is on the track; a nest is often indicated at some distance by the smell of the putrid contents of the larder, or by feathers and droppings at the foot of a tree or precipice. Eagles are mostly always moulting, so cast feathers often betray their whereabouts. In the old clan days three feathers were the badge of a chief, two of a chieftain, and one of a gentleman. The usual clutch is two; it was anciently believed that the one egg contained the male, the other the female, so plainly marked that experts could distinguish the sex! In flight there is no mistaking the sexes, for the male is considerably the smaller, the female often weighing 12 lbs. Tip to tip, the wings measure from six to nine feet; the length of body, from tip of bill to tip of tail, being about three or four feet.

Despite, however, the protection afforded eagles by sportsmen, the eggs are so valuable that many a man succumbs to the temptations of collectors. When the market price of eggs is from £1 10s. to £2 each little wonder that now and again some of the natives turn their knowledge into gold! Certain feathers, too, are valued by fishermen, a fact which does not tend to prolong the years of the birds. The deerstalker encourages the eagle because it keeps down grouse and hares, which otherwise, by giving the alarm, would cause the loss of many a good stag. Moreover, the eagle is really one of the scavengers of the forest. Last winter the writer accompanied a hind-shooting party in Strathspey, when an old toothless beast was allowed to remain on the heather, the venison being useless. The party had scarcely left the carcase when a hen eagle was observed making directly for it, doubtless with the view of holding an inquest, but on seeing the stalkers it flew off in another direction. Scarcely had it disappeared when the cock eagle came on the scene, but similarly recognising danger it diverged in the wake of its mate.

Doubtless eagles are occasionally driven to great straits for food, so they gorge when opportunity offers, and are sometimes caught alive before they can get into position for flight. Their *bonne bouche* in the forest is grouse, ptarmigan, and hares, but nothing comes amiss. Thus a Glen Garry eyrie had two lambs, which had been carried a considerable distance, and a young fox. Dogs, too, fall victims; we have only to refer to Johnson's "Journey to the Western Islands," but recent incidents within our own knowledge confirm his statements. Rabbits are often hunted by eagles in couples, as, indeed, are other game. We have watched eagles so engaged for half an hour without getting even one "bite"; in dignified disgust they rose high in the air, flew over an intervening corrie and settled down on the next mountain. Eagles have been credited with improving sporting moors by destroying diseased grouse, but this is an undeserved compliment, for often as not the diseased bird is dropped at once. A gamekeeper reports a rather curious comedy when an eagle set several rabbits off at their best speed. As one frightened bunny disappeared in a hole the eagle came to earth, peeped in, and even put forth a claw—and then made off! A full-grown fox and an eagle have been seen "jockeying" each other for about an hour, neither venturing to come to close quarters. "Dens" also are sometimes watched; in one instance a cub attempted to come out, when the eagle made an unsuccessful grab, a performance which was repeated again and again.

A few years ago a Mull deerstalker saw an exciting attempt of an eagle to get possession of a kid. The nanny-goat made a determined defence, the deerstalker finally coming to the rescue with his rifle—a shot in the air being a sufficient hint to the eagle to make off. Even red deer are well known to fall victims by being driven over precipices. The writer has seen a herd of thirty stags in a state of great nervousness on account of the immediate vicinity of an eagle. Fawns are very frequently attacked, and roe deer also suffer not a little. Mr. James Cameron told the writer a curious incident he had recently witnessed in Balmacaan Forest—an eagle plucking several "clawfulls" of fur from a fallow buck's back, the deer finally escaping by

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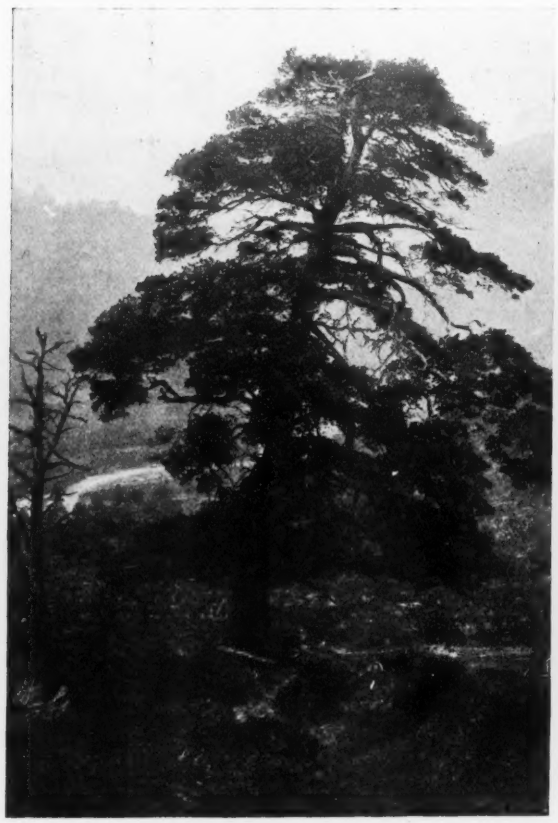
running into a wood. If the mountain eagle recognises any relationship with the osprey, that does not prevent it from attacking the fishing-hawk when it has got a trout in its claws.

Sometimes the eagle's eagerness has helped to its own death. One was seen to attack a sheep, its talons becoming fixed in the wool, on which a shepherd came up and despatched the bird with his stick. The warfare of shepherds against them has even taken the form of laying down a poisoned lamb. In Glen Avon, a noted deer forest, an eagle swooped on an animal with which it flew away. Immediately, however, it made a rather peculiar descent, so the forester walked along to see the *dénouement*, when he found the eagle quite dead with its talons transfixed in a pole cat. The latter was also dead, its teeth closed on the eagle's gullet.



Photo, Seton P. Gordon.]

Eagles' Eyrie on a Scots Fir.

In short, no living thing comes amiss as food to a couple of eagles when they have clamorous youngsters in an eyrie. The latest find we know in a particular nest was a fawn, a mole, and two hares, quite untouched, as it happened. The lifting power of an eagle is, as can be seen, very considerable, though many have doubted its strength in this respect. In October, 1901, an eagle was observed in Glen Callater, near Braemar, in the act of flying away with a large fawn. The young deer had been gambolling about, quite unconscious of danger, when the great bird fixed on its back. Alarmed, however, by the outcry raised by the stalkers, the eagle let go its dangling captive, which fell to earth apparently little injured.

Eagles are not cannibals, and fights between them are extremely rare, especially when one considers how frequently stags attack each other in the rutting season. Two were sent south in a big hamper from Meggernie Castle in Glen Lyon, but only one arrived alive in England; for some reason or other the stronger had made an end of the weaker. We know of only one eagle fight in recent years; it occurred in the famous deer forest of Glenquoich, so long leased by the late Lord Burton. Quite close to the road were two eagles tearing at each other, both bleeding from beak and talon wounds. A flock of crows was enjoying the rare spectacle, but on two men appearing the combatants flew off in different directions and only the crows were left chattering on the field of battle.

Logan's "Scottish Gael" (1831) has a rather curious story, which is at least interesting if not true. "Two eagles had built their nest in the neighbourhood of a gentleman's house in Strathspey, and the quantities of game which they collected were truly astonishing. On the arrival of any visitors, however unexpected, the gentleman had only to despatch someone to the eagles' eyrie, when an ample supply of hares, rabbits, moorfowls, partridges, snipes, etc., was speedily secured."

Photo, Seton P. Gordon.]

Two Eaglets, Eight Days Old.

Eagles have a peculiar trick of dropping their captures, only to catch them up again and again. In one case an eagle was seen to drop and catch a grouse three times, an incident well established in our informant's memory, for he fired no fewer than eight unsuccessful shots at the eagle. One of a couple of eagles killed a ptarmigan by a wing stroke, on which its companion made off with the dead bird, which was not allowed to fall to earth.

Eagles, in teaching their young to fly, drop them repeatedly from their backs, receiving them again ere they reach the ground. The cries of the eaglets as they imagine they are to fall to the bottom of the corrie would be piteous to hear if they were not so comical in

the circumstances. There is no mistaking the strong affection of the parent birds.

Their eggs are often hatched in long continued snowstorms; nothing will make them forsake their nursery. Yet when the youngsters can do for themselves they are literally driven forth—a wise provision of Nature, otherwise they would perish for lack of food. Eagles are never seen in flocks; it is exceedingly rare to observe more than four together. Such a quartette is probably a family party—the parent birds and their youngsters of that season. They live to a great age; a fine specimen was kept in captivity in Vienna for 104 years. It is really marvellous and pitiable how widely spread has become the cruel custom of keeping them in so-called eagle-houses; only in Zoological Gardens with ample accommodation should confinement be tolerated. The mountain eagle in captivity is a sorry sight—it is never seen to advantage; nothing can be learned under such circumstances of its natural habits. They decline to be tamed, moping continuously; the laying of an egg is all but unknown. The

Photo, Seton P. Gordon.]

Mountain Eagles' Nest with Eggs.

New London Dispensatory of 1676 gravely informs us that "the Eagle can fly from Morning till Night, and that very high; they see well, and have the best smell of all living Creatures; they live till very old, and die by reason of their crooked bills." The flesh was accounted "Medicinal against the Gout." We never happened while on the mountains to find the dead body of an eagle, though long familiar with dead birds from ptarmigan to heron, so we dare not contradict the cause of death!

Traps for vermin are sometimes the accidental means of capturing eagles, who, however, often regain their liberty at the expense of a toe. This explains how it is that so many stuffed specimens are minus a claw. Not always, alas! is the trap so easily got rid of. In June, 1847, an eagle was caught in a trap in Strathrick; it pulled and pulled till it drew out the stake and flew off with the trap, which weighed five and a half pounds. The bird thus handicapped was several times seen crossing and re-crossing Loch Ness, but the following month it was found dead in Glen Moriston, sixteen miles off. Five years ago a Ross-shire farmer, while out on the Ardgay Hills at his sheep, saw an eagle gradually fall to the ground as though thoroughly exhausted. On coming up to it, it was seen to have a rabbit trap attached to one of its legs.

A friend of the writer's, in Benalder Forest, saw in April, 1903, an eagle flying with a trap; the following December he once more caught sight of it. An Atholl stalker had a trap set for hawks with which an eagle made off. He saw it flying thus handicapped a fortnight later. A young eagle, probably exhausted by a long flight from the westward, flew against the Girdleness Lighthouse, near Aberdeen, on September 23, 1839, and was captured alive, having become entangled in the top. A considerable flight of an eagle with a trap in Kincardineshire was described at the Aberdeen meeting of the British Association in 1859. We had the good fortune to be present when a forester set free an eagle from a fox-trap. At first the eagle was almost powerless to move, but by and by it succeeded in flying off.

The vitality of eagles is extraordinary. An eagle

Photo, Seton P. Gordon.]

An Eaglet.

accidentally killed (as was thought) in Strathconan Forest was being stretched out on the heather so as to ascertain the alar measurement, when lo! it moved its head from side to side, then gave a flap or two, and flew over the corrie! It soared and soared till it became lost in the clouds—to the surprise and satisfaction of all concerned. A curious incident happened at Ben Hee, in Sutherlandshire, some fifty years ago, at a time when rewards were there offered for destroying eagles. William Ross, a noted fox hunter, found an eagle in one of his traps, on which he killed it with a stick, temporarily placing the body in a cairn of stones. When he returned next day for his dead bird he discovered that it was very much alive. He "killed" it for the second time, and now placed the body within his plaid, going off with the burden over his shoulder. He had not gone more than two miles when he felt its talons in his back, on which he threw off his plaid as quickly as possible and made sure there should be no more coming to life! There is one sad fatality to record in connection with the shooting down of eagles. Sixty years ago Dugald Macleay, a stalker in Rhidorach Forest, met his death in a rather extra-

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ordinary manner. He had fired one barrel at an eagle —a meritorious act as then accounted—and the wounded bird fell, on which he proceeded to finish it off with the butt end of his gun. Then the other barrel went off and he received the contents in his body.

All manner of birds seem to delight in chasing or following the eagle; it is wonderful how it puts up with such insults—like a giant secure in its strength, it rarely deigns to use it. Even such birds as rock-doves dare to approach it, and the peregrine falcon pretends, at least, an attack. Hoodie crows have a great antipathy to the eagle, and may often be seen mobbing it. We know of only one instance where their temerity was fatal—in Strathconan Forest one hoodie was just a little too impudent and an avenging claw made a clutch.

The courtship of a pair of eagles once seen will never be forgotten. They appear to sail high up in the sky, circling round and round each other, always about to touch, but rarely coming into actual contact—wooing of a dignified character, but quite evidently love-making all the same. As one lies on the heather eagerly watching with the telescope how it is to end, the birds will probably disappear over the next ridge. A naturalist friend, who was perched on one of the Cairngorm Mountains, thus described an incident he observed: "The two eagles high up in the blue sky seemed to conduct their courtship in ceremonious and even solemn dignity. They sailed round and round in a wide circle with, as far as could be discerned, unmoving pinions, except when they occasionally broke the circle, caressed each other, and then resumed their circle-sailing till by and by they circle-sailed out of sight."

The eagle is, as a rule, a silent bird, having the reputation of being a saturnine fellow. Nevertheless, the eagle has its likes and dislikes, and its memory is by no means short, though it very rarely, except in its own immediate family circle, gives expression to its finer feelings. Once mated there is neither separation nor grounds for it; only death parts them, and the survivor mopes and mourns. A Sutherland keeper had to pay frequent visits to a cage where an eagle was kept, but the bird never appeared to take any particular notice of him. He unexpectedly had to remove south for two years, but on returning his welcome was evident. For the eagle recognised him afar off—to be precise at a distance of forty yards—and showed such signs of pleasure that there was manifestly a bond of union between bird and man.

OZONE is the best agent for purifying water, because it adds nothing except oxygen, which assists in aeration. An ozonising plant has recently been installed at Saint Maur, near Paris, where the water of the Marne River was found to contain many disease germs, even after it had passed through sedimentation basins and sand filters. The ozone generators are of the Siemens type and are operated by a high-tension alternating circuit obtained by transforming the current of a 110-volt alternator, which is driven by a 44-horse-power steam engine. The total consumption of energy is 1 kilowatt hour for each 1,200 cubic feet of water, and more than half of the energy is employed in working the compressing pumps. The cost of sterilisation is less than 5 cents per thousand cubic feet. The temperature of the water is lowered by the operation, and not a trace of nitrous oxide, chlorine compounds, hydrogen dioxide, or metallic salts due to corrosion of the apparatus can be detected in the sterilised water. Of the ozone absorbed, 73 per cent. is consumed immediately in sterilisation, 7 per cent. remains diffused through the water and exerts a subsequent sterilising effect, and 20 per cent. escapes into the atmosphere.

Motoring on the Source of the Nile.

By B. WHITEHOUSE.

BEFORE Asia was crossed by the inevitable motor car the motor boat had left its oily trail on the head waters of the great river, knowledge of which was for so long regarded as the greatest prize for exploration.

Captain Speke, on his discovery of the Victoria Nyanza in 1858, heard of the large river flowing in on its west coast; and crossed it himself in 1862, calling it the Kitangule-Kagera. Later it was considered to be the highest source of the river, and received the

Fig. 3.—Muanza.

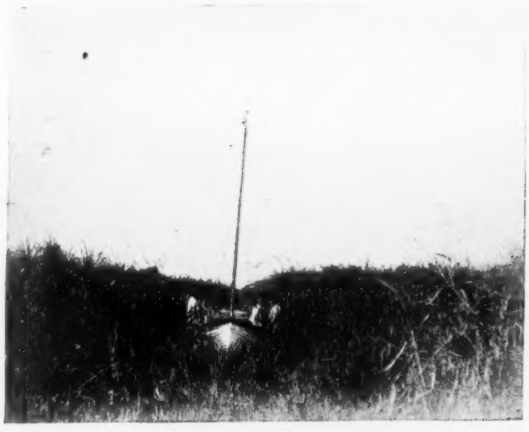


Fig. 4.—A bad landing at the extreme South of the Nyanza.

name of the Alexandra Nile, its native name being the Kagera. Its mouth is a short distance north of German territory, and it is the only river on the lake that boats can ascend to any distance, a bar at the entrance preventing its use by larger vessels.

The motor cutter *Humming Bird* was employed during 1904-06 on the survey of the Nyanza. She was built of steel on the pattern of a man-of-war steam cutter, and driven by a petroleum motor of 10-h.p. Russian petroleum from the Shell Transport Company's Depôt at Mombasa was used, and the boat was capable of, and performed, much more work than any steam boat could possibly have done under similar conditions. In 1905-06 she

was under continuous work for about eight months, during which she usually towed two heavily-loaded 30-foot whaleboats. Sufficient petroleum was carried on each trip for a run of about 750 miles, the speed obtained, under good weather conditions, being about $7\frac{1}{2}$ miles an hour, 6 with one whaleboat, and 5 to $5\frac{1}{4}$ with two in tow, for an expenditure of about one gallon of petroleum an hour. Towing the whaleboats, she circumnavigated the Nyanza, with the exception of about 40 miles, over which she was towed when the survey expedition was on its way back to Port Florence, covering over 3,000 miles and thoroughly proving what she was capable of.

Fig. 5.—Papyrus and Victoria Regina lilies at a bad landing.

Fig. 6.—The most beautiful spot on the Nyanza, Kisingere Bay.

The crews of the flotilla, with the exception of the Indian driver of the motor, were all natives of the Lake districts, eight different tribes being represented among the nucleus crew.

There was a good deal of variety in the camping places on the lake shore, some, as shown at Muanza (Fig. 3), being very good, while others, as shown at the extreme south (Fig. 4), were equally bad, being approached by long channels in the papyrus (Fig. 5), the whaleboats having to be forced through masses of lilies that would have commanded good prices at Covent Garden, the sort of spot at which retreat under a mosquito curtain was absolutely necessary at sunset.

The most beautiful spot on the Nyanza is certainly in Kisingere Bay (Fig. 6), where a good view is obtained of Gwasi, a mountain whose summit is over 3,000 feet above the lake, and the highest anywhere near it.

Fig. 7.—Camp on Alice Island.

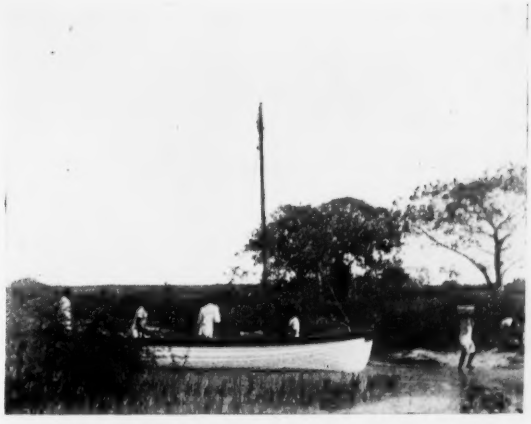


Fig. 8.—Landing on Godziba Island (C.M.S. Island).

Fig. 9.—The beach at Bukoba.

Kerebe Island (Fig. 7), named Alice Island by Sir H. M. Stanley when visited by him in 1875, lies about 22 miles out in the lake from Bukoba, and has a few

antelope in the wood on its summit. The *Humming Bird*, getting blown adrift in the night during a storm, had a narrow escape of finishing her career there.

Another island visited was Godziba (Fig. 8), discovered and named "Church Missionary Society Island" by Mr. Mackay, the well-known missionary, and not visited again by any European until the *Humming Bird*, with one whaler in tow, took the survey expedition there from Muanza in three days, a distance of 90 miles, and back by another route in two days, a distance of 77 miles, the inhabitants of the island, which is only just visible from one other point on the lake, being greatly surprised at the visit and

Fig. 10.—Hauling a seine net near Port Florence.

Fig. 11.—Fishermen on a papyrus raft near Port Florence.

the rate the boats travelled, while they were quite unable to understand how they got along at all "without paddles."

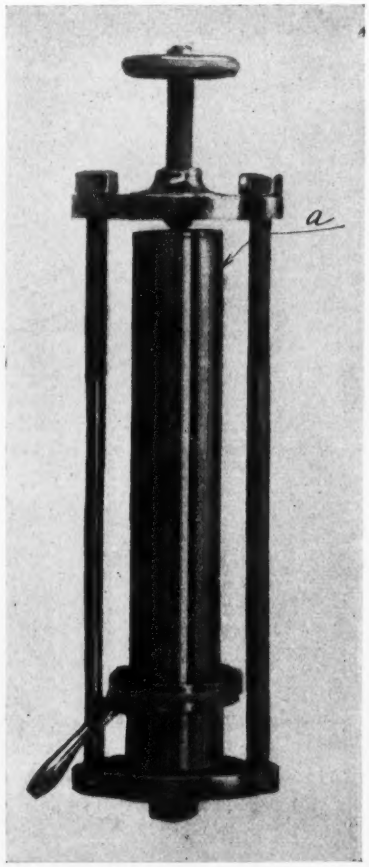
On the west the coast is exposed, as is shown on Bukoba beach (Fig. 9), the roadstead being open to the whole breadth of the lake.

A seine net brought cut from England in 1903 was occasionally used (Fig. 10), much to the admiration of the local fishermen, who would work laboriously all day on a raft of papyrus (Fig. 11) to get, perhaps, a few pounds of the smallest-sized fish, with "many thorns," namely, full of bones.

Filters for Ultra-Microscopical Particles.

By DR. ALFRED GRADENWITZ.

DIFFERENT processes are used for purifying alimentary and industrial liquids. The most effective and economical of these at first sight would seem to be sterilisation by heating. Recent researches have, however, shown that, apart from the evident loss of savour, both the digestive and nutritive properties of liquids thus treated are greatly impaired. Furthermore, filtration cannot be dispensed with, even after sterilisation, with a view to removing its turbidity.



Exterior View of MM. Gobbi and Taine's Filter.

An efficient filtration would doubtless be able to yield more advantageous results. However, the filtration devices (designed on the principle of the Chamberland candle) which are at present in use show a number of disadvantages. The filters, in fact, keep back the minute particles by the molecular adhesion on the filter walls rather than by the narrowness of their filter channels, so that the microbes contained in the liquid after some time (in some cases after from three to four hours) begin to pass through, either in virtue of their multiplication in the interior of the filtering channels, or by their lively movements, which eventually throw them beyond the range of capillary action. Furthermore, these filtering candles allow viscous liquids to pass only slowly.

Dr. Bechhold, of Frankfort-on-the-Main, some time

ago suggested a new principle of filter construction, which consists of passing the liquid through a gelatine layer. More recently two French engineers, Messrs. E. Gobbi and E. H. Taine, have carried out successfully another system of construction recorded in a communication to the French Academy.

The two inventors have endeavoured, primarily, to solve the task of avoiding any rapid obstruction of the filters, while making the filtering process both cheaper and safer.

To this effect they discarded any porous substances, either of mineral or vegetable origin, using only unalterable, resisting, and relatively cheap materials. The apparatus was, finally, to be so designed as to be always got into working condition merely by washing, without being unmounted, while lending itself for the filtering of the most variable liquids.

The filters submitted to the Academy are mainly based on the narrowness of the channels, the microbes being arrested by the extreme smallness of interstices, definitely and not temporarily, as in the case of capillary attraction, which latter is reduced by making the filtering interstices shorter and more regular, so as to allow of the integral passage of toxines, diastases, and other viscous liquids. These filters thus arrest, during some hours—even for the space of a day—the colloidal grains of dyeing substances, and are maintained indefinitely sterile.

The filters consist of a nickel tape 1/10 millimetre in thickness and 1½ millimetres in width (length of the filter path). This tape, some hundreds of metres in length, is wound helicoidally on its broad side, the various spires being forced against one another by means of a screw, so as to form a compact cylinder.

This cylinder could be rendered impervious by straining the screw, but for a series of minute transversal ridges projecting from one of the faces of the tape at very short distances from one another. In this manner are obtained very regular interstices of the dimensions most convenient for the industrial or scientific application at issue. The protuberances and, accordingly, the interstices, can, for instance, be reduced to dimensions smaller than those of the most minute microbes; while the width of the tape can also be reduced with a view to diminishing the friction of the liquid.

The remarkable smallness of the interstices of this filter (which, by the way, could be even made of smaller dimensions) allows not only the microbes, as in the case of ordinary filters, but even the grains of colloids, which are far smaller than the former, to be arrested, and thus really warrants the name of ultra-microscopical filters.

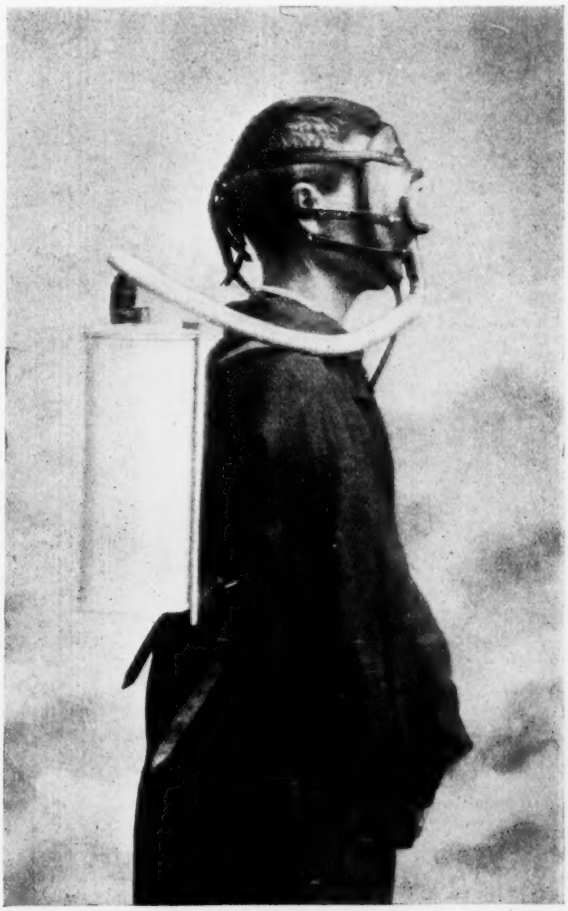
Black Diamonds.

THE average size of the black diamonds which are used to point drills for boring purposes ranges from two to five carats, but the larger specimens give much better results. They cost more, but they last longer. Consequently, there is a greater demand for the larger pieces of pure carbon, and the price is sometimes run up to premium figures for unusual specimens. The fear that the supply of black diamonds may some day give out and paralyse the diamond-drilling industry has stimulated prospectors to systematic search for new deposits; but so far they have not been successful. On the other hand, scientists have been making a close study of the chemical conditions which have produced the black diamonds; but their manufacture is apparently as difficult as the making of the gem diamonds. It is possible under certain conditions to make either, but not in sizes sufficient to be of any commercial value. Nature in some peculiar way has made these rare products, and then thrown the secret of the process away. If any man can ever unlock or find that secret, he may cause a panic in the diamond trade.

A Novel Respiration Apparatus.

A SUCCESSFUL attempt to use liquid air for the feeding of respiration apparatus, as used in rescuing work, has been made by M. George Claude, of Paris, the well-known worker in the field of air liquefaction. This apparatus avoids, for instance, the harmful variations in composition occurring in the case of liquid air, and ensures the highest efficiency attainable in this connection.

The liquid oxygen is contained in a metal tank and locked efficiently by incombustible glass wool, so that



The apparatus in position.

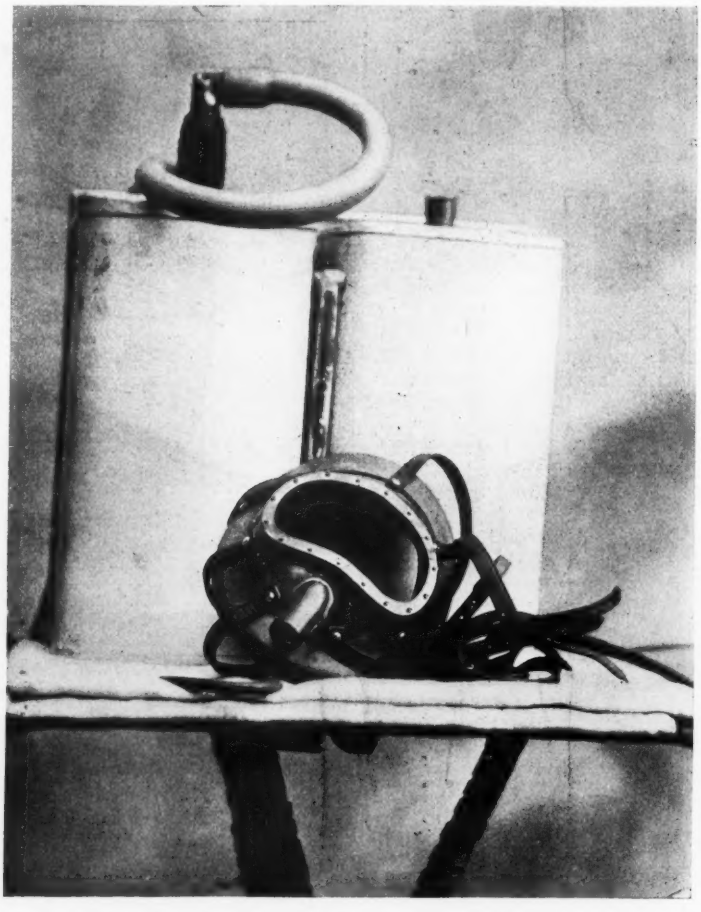
the operator may, without any inconvenience, assume any position entailed by his work. The tank is surrounded by an incombustible heat insulator (likewise glass wool), the high efficiency of which has been borne out by practice. This heat insulating material is placed in another very substantial metal tank. All the parts of the apparatus are so strong as readily to resist any mechanical strain, which is an undoubted advantage over previous designs.

The heat insulation obtained by this arrangement ensures an evaporation lasting 2-2½ hours. The apparatus is free from any double-walled vessel with vacuum between the walls, as these devices—while being far too delicate to handle—by cutting off any

outside heat, just prevent the very purpose of the apparatus—the production of a lively evaporation of liquefied gas.

The oxygen supply is very plentiful, the 12 litres of liquid oxygen being reduced in two hours to 1,200 litres of gaseous oxygen, corresponding to a rate of 600 litres per hour, which is five times the amount necessitated by a hard manual worker. However, this abundance does not mean any waste of material; on the contrary, it affords another advantage: In the apparatus most in favour at the present time, which is based on the use of compressed oxygen, the very considerable weight of the oxygen bottles entails the utilisation of absolutely the whole of the oxygen carried by the operator. So far from discharging into the open the products of respiration, which still contain much oxygen, these are made to pass over cartridges of regenerating matter, in which the water and carbonic acid are absorbed. In the Claude apparatus this costly and inconvenient complication is avoided, only the most exhausted gases (viz., those obtained at the end of each respiration) being discharged, while the breathed-out gases, not discharged, which still contain enormous amounts of oxygen, are kept surrounded by an atmosphere of fresh oxygen.

The vaporised oxygen does not go directly to the mask; as evaporation is a continuous and relatively slow phenomenon, while inspiration, on the contrary, is a practically instantaneous process requiring a considerable gas volume, some intermediary is obviously required. The vaporised oxygen is, to this effect, thrown out, first into a caoutchouc bag of 5-6 litres capacity enclosed in another substantial metal reservoir, and thence is supplied to the mask through a tube of sufficient cross section. The mask is applied on the face by a device, ensuring a sufficiently tight closure, in spite of any variations in the form of faces. A special advantage of this arrangement is that the slight depression produced during respiration applies the mask more tightly against the face, thus absolutely preventing the entrance of any traces of vitiated outside air, whereas during expiration the mask allows the expired air to escape into the open, when, at the end of expiration, the caoutchouc bag is filled both with the products of expiration and the oxygen vaporised between two successive inspirations. The most vitiated gases are thus expelled automatically, without the aid of any special mechanism, and this is why the proportion of expired gases in the bag is never inconvenient, in spite of the absence of regenerators and the use of such small amounts of liquid oxygen. This strikingly illustrates the extreme simplicity of the apparatus, which, strictly speaking, does not comprise any mechanism and thus is free from any risk of breakdown.



The Mask and the Liquid Air Vessels.

Where to Find the Stars
(A Link Between the Star Maps and the Sky).

By F. R. RUSSELL.

IT is very difficult to recognise stars by studying the star maps and then seeking in the sky the stars marked on the maps. But if we come to know our way in the heavens, so as to be able to find readily the Celestial Equator, Celestial Poles, Ecliptic and our Zenith, and notice the position of a star relative to these points and lines, it is not at all difficult to refer to the same places on a map and to find the name of the star desired and the constellation to which it belongs.

To know our way thus in the heavens we must always remember the exact point on the earth from which we are looking. The earth is divided into 360 degrees north and south, and 360 degrees east and west, and the vault above us is divided into corresponding degrees. The equator divides the earth into two equal parts, and the line due north and south connecting the poles is at right angles with the equator.

As the earth is divided into 360 degrees north and south, the heavens which enclose it are likewise divided into 360 degrees. We can see half that amount, 180 degrees, at one time. The other half envelopes the half of the earth below our feet and is, consequently, invisible to us. We see 90 degrees from the horizon on our right-hand to our zenith and 90 degrees from the horizon on our left to our zenith. Our zenith being the exact point overhead where we may be standing at any given time.

If we are placed on any spot between pole and equator we see these latter landmarks at different angles in the heavens. At Greenwich, which has the latitude 51½ N., the parallel in the dome above us is 51½ N. at our zenith. We see 90 degrees between the celestial equator and the celestial north pole, and the remaining 90 degrees is made up by the difference between north pole and our horizon on the one side, and between the equator and our horizon on the other side.

The celestial equator, seen from latitude 51½ N., is rather less than half-way up between the southern horizon and the zenith, and the celestial north pole is rather more than half-way up from the northern horizon. That is, we see from our northern horizon to the north pole in the heavens 51½ degrees from the pole star to our zenith 38½ degrees, making 90 degrees from horizon to zenith on the northern side. On the other hand, if we face south instead of facing north, we see from the southern horizon to the celestial equator 38½ degrees, and from the equator to our zenith 51½ degrees. That is, 90 degrees from the southern horizon to our zenith, and 90 degrees from the northern horizon to our zenith—180 in all.

Only the stars travelling on that portion of the heavens are visible to us from our latitude.

Our horizon line on the south is 38½ S., and our horizon line on the north is 38½ N.

In Oporto, Portugal, latitude 42 N., the horizon lines are 48 N. and 48 S. In Wellington, New Zealand, latitude 42 S., the exact reverse holds good, the South Pole taking the place of North Pole, and the southern horizon that of northern horizon. In the northern hemisphere the southern horizon is so many degrees *below* the celestial equator, according to our latitude, and the northern horizon is so many degrees *above* the celestial equator which is not visible to us from that side.

From atmospheric conditions heavenly bodies look larger, and the space they travel through seems greater, when near the horizon, and a planet or star at 45 degrees above the horizon will look more than half-way up to the zenith, which it, in fact, is.

In the heavens degrees count from the equator to the pole as on the earth, the equator being 0 and each pole 90; but instead of calling those degrees parallels of latitude they are called *declensions*, though they correspond with our terrestrial latitudes. Standing on lat. N. 20 (as in Mexico) the corresponding line overhead is also 20 N., but a heavenly body on that line is said to "have the *declension* 20 N."

To find our way east and west in the heavens is more difficult than north and south, because the earth's motion has to be taken into account. The earth has many and complicated movements on its journey through space, but the only two that much effect us in watching the stars are the diurnal one as it turns on its axis every 24 hours from west to east, and the annual one as it journeys on its path round the sun every year, also from west to east.

A position on the earth east and west is determined by meridian lines of longitude. Any line drawn straight from pole to pole, cutting the equator at right angles, is a meridian line.

The line through Greenwich is chosen to count from by all English-speaking countries, and is called the First Meridian. The earth being divided into 360 degrees, 180 east, and 180 west.

Most Continental towns count from the meridian of Paris, instead of that of Greenwich. There are also meridian lines in the vault above us, but instead of being called longitudes they are called right ascensions.

A line in the heavens which is directly over a certain place at 12 noon will no longer be over that place at 1 o'clock, because the earth will have shifted itself eastward a twenty-fourth part of its diurnal journey in that time, or 15 degrees. If the sun is over the meridian of Greenwich at 12 o'clock, as the earth revolves eastward at the rate of 15 degrees an hour, the sun will be directly over the meridian of all places 15 degrees west of Greenwich an hour afterwards, when it is one hour after noon at Greenwich.

When the sun is directly over the meridian of any place it is mid-day or noon to that place. As the sun rises towards the east and sets towards the west, when it crosses the line due north and south, or the meridian, it has made half its journey, and is, consequently, at its highest point in the heavens. It is the same with the stars.

As the earth revolves on its axis every 24 hours the whole dome of stars appear to turn round over our heads in that time. That is, if we were standing on one of the poles, with the corresponding pole in the heavens directly in our zenith, we would see all the stars make a circuit round the point overhead, as though we were standing still in the centre beneath a revolving dome. The stars near the pole make a very small circuit, while those further off move in a larger circle, the circles growing larger and larger until they reach the horizon, when, being on the celestial equator, they circle the whole round of the heavens.

On the contrary, if we were standing on the equator we should see all the stars rise and set, some travelling right overhead, rising due east and setting due west, others whose circuits are smaller ones nearer to the poles rise to the north or south of east and set to the north or south of west, their path making an arc in the sky, but never reaching the zenith.

At 20 N. lat. (in Mexico, for instance) almost all the

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stars disappear beneath the horizon, only a very few whose declensions are very near the North Pole being visible in their entire circuit.

This diurnal motion of the stars round the pole makes it easy to find the pole in the sky. In the northern hemisphere there is a star, the Pole Star, within 2 degrees of the celestial north pole, and any night the surrounding constellations can be seen circling round this point.

As the journey round the pole takes 24 hours, the difference in their position every 3 hours is very apparent, being an eighth of the whole distance. If we look at the Great Bear any night at 9 o'clock, and again at midnight, it is easy to recognise this motion of the stars. The stars nearer the pole have a small circuit, and those beyond the Great Bear have a larger and larger one, according to their distance, and, consequently, sooner or later, dip below the horizon. In the southern heavens there is no star like the Pole Star in the north, but the South Pole is easily recognised as the pivot round which the constellations turn. The Southern Cross, with its pointers, the two bright stars in the "Centaur" and "Triangulum Australis," nearer still to the pivot of the southern heavens, can be watched circling round the southern pole night by night, at all seasons, in the same way as the Great Bear circles round the North Pole.

The apparent path of the sun is called the "Ecliptic." There are certain constellations like a broad band, through which this ecliptic runs, and which make an easy mark in the heavens and help us much in finding our way in the sky. These constellations are called the zodiacal constellations, and are each marked by a sign of the zodiac peculiar to itself. They are visible at night only at certain seasons of the year, depending on the position of the earth as it travels round the sun among the stars.

The stars whose circuits are small and near the poles are visible every night of the year in their respective hemispheres, but those that circle round the equatorial regions are visible at certain seasons only; at least, early in the night. This is easily understood if we take a ball of wool and lamp as an example. As we move the ball round the lamp in the centre of the room, the ball represents the earth, the lamp the sun, and the walls of the room the star-sphere. The path in which the ball is moved represents our orbit, or path round the sun, and it will be seen that as it travels round the lamp (or sun) is sometimes between us and one side of the room and sometimes between us and the other side. When the sun is between us and one side of the star-sphere that side of the star-sphere is concealed from our view by reason of the light of the sun, while the other side of the star-sphere is visible to that half of the earth which is turned from the sun and to which it is night. Each half of the earth is alternately every 12 hours in light facing the sun with the invisible heavens beyond, or in shade facing the visible heavens without the sun.

As we travel round, the sun appears in a line with every constellation on the ecliptic in succession. The lamp is, as it were, projected against, first one object, then another, on the walls in a line behind it. Our journey round the sun takes a year, and twelve constellations have been noted at nearly equal distances, through which the sun appears to travel, and are called zodiacal constellations. When the sun is projected against, or in a direct line with, one of these it is said to be "in" such-and-such a constellation. At that time this constellation is invisible at night, because it has set with the sun, having risen with the sun in the morning and travelled with the sun across the sky during the day. All the stars in the equatorial regions have their seasons in the same way.

We see 180 degrees or half the heavens at a time, thus six of these zodiacal constellations are visible at once. The earth moves round the sun from west to east, taking 12 months for the journey, and being in one of these constellations each month. Consequently, if one constellation has set with the sun in the west, the next eastward to it will be the distance of a twelfth part of the ecliptic above the western horizon, and in the next month will be setting with the sun in its turn.

As the earth in a year completes its journey through the dome of stars, travelling from west to east, we are always moving on this journey as well as turning on our axis.

If we only turned on our axis we would find any given star in the same position at the same hour, night after night. As it is, the earth, having moved eastward on its annual journey to the amount of one degree, any given star appears further west at the same hour, each night, to that amount. One degree represents four minutes in time, so that a star being one degree westward each night is seen four minutes earlier above the eastern horizon, or, to express it otherwise, rises four minutes earlier every night—roughly speaking, half an hour a week and two hours a month. Thus, if we look for a certain star at a certain spot in the heavens at 10 o'clock to-night, we must look for the same star at the same spot at 8 o'clock a month hence. Or, otherwise, if we seek for a star on our meridian at 8 o'clock to-night, we must look for the same star 30 degrees west of the meridian at 8 o'clock a month hence.

The position east and west of each star in the heavens is mapped out in the same way as its position north and south. The 360 degrees north and south are, as we know, counted from the equator to the poles and are called "Declensions."

The degrees east and west are counted from the point in the heavens where the sun is found at the March Equinox, that is, the first point in "Aries," one of the zodiacal constellations, and are called "right ascensions." They are counted either in degrees 360, or in hours 24, each hour representing 15 degrees. Wherever we may be on the earth we see the sun cross our meridian at 12 o'clock; this tells us our position in regard to the sun, but it does not tell us the earth's real (and the sun's apparent) place among the stars at any given date. This is calculated by "right ascensions." Each star has its position in regard to the 1st point in Aries mapped out so many degrees (or hours) East. When the sun appears in a line with such-and-such a star of such-and-such a "right ascension" we know our place in the heavens at the time, and how far we have travelled on our annual journey from Aries back to Aries again. Each star has its "right ascension" and this right ascension comes to our meridian once in every 24 hours as we turn on our axis. The "right ascension" and declension of every star is given in most star atlases and almanacks, and the hour of each star's passing the meridian of Greenwich at different seasons is generally added.

By knowing the part of the ecliptic where the sun is at a given date and the right ascension of the constellation with which it is on a line, it is easy to compare the right ascension of any given star and to see if it has passed the meridian before the sun, when we cannot look for it early in the night, or whether it will pass the meridian soon after the sun, when we may

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look for it to be visible in the heavens as soon as the sun has set.

Seeing Aries just above the horizon, setting in the west, we may look for Libra soon to rise in the east, as, if the sun is now in Aries, it will be in Libra 6 months hence, and Libra will then be setting at sunset, and has, consequently, half the heavens to traverse in the six months. Between Aries and Libra come Taurus, Gemini, Cancer, Leo, and Virgo, visible in succession across the ecliptic.

If we refer to our almanack and find the sign in which the sun is at the date we seek we may look for the zodiacal constellations of the six months following, in the sky after sunset, the remaining six constellations being below the horizon.

The signs of the Zodiac are written as follows:— ♈ (Aries), ♉ (Taurus), ♊ (Gemini), ♋ (Cancer), ♌ (Leo), ♍ (Virgo), ♎ (Libra), ♏ (Scorpio), ♐ (Sagittarius), ♑ (Capricornus), ♒ (Aquaris), ♓ Pisces).

The first six are north, and the remaining six south, of the equator.

Most of the zodiacal constellations are conspicuous by one (or more) bright star.

Aries possesses one star of the 2nd and two of the 3rd and 4th magnitude, making a curved line.

Taurus is easily recognised by the brilliant 1st magnitude star Aldebaran, which is accompanied by a V-shaped cluster of bright stars forming a figure not unlike a bull's head. Aldebaran being at one point. The constellation of the Pleiades, a cluster of six bright stars, is in the bull's shoulder.

The *Gemini* consist of two brilliant 2nd magnitude stars (sometimes counted as 1st magnitude) of nearly the same size, and of many smaller stars forming the continuation of the Twins as far south as Orion.

Cancer is a miserable little group hardly discernible, forming a sort of square, and is best found by being on the direct path of the sun, between Gemini and Leo. There is no star above the 4th magnitude in it, but this constellation is often quoted, as the sun is in the sign of Cancer when it reaches its highest point north $23\frac{1}{2}$ degrees. Cancer contains a remarkable nebula, not visible to the naked eye.

Leo is shaped like a sickle, with a beautiful 1st magnitude star, Regulus, in the handle.

Virgo stretches a long way across the heavens, its most southerly point ending in Spica, a 1st magnitude star 10 degrees south of the equator representing the ear of corn which the Virgin holds, the sun being in Virgo during the harvest month in the north.

Libra, the balance, is entered by the sun at the September Equinox. It is not very unlike the Twins, having two stars in a straight line, of an equal size, but the stars are not so large as Castor and Pollux, and are not so close together. This constellation is quite eclipsed by the one following it.

Scorpio, the scorpion, which not only boasts of Antares, an exquisite reddish star, as its "heart," but has two bright 2nd magnitude stars at its southern extremity, and a cluster of bright 3rd magnitude stars at the northern, close to Libra.

Sagittarius, the Archer, comes next, also south of the equator, with four bright stars (of 2nd and 3rd magnitude) making a kind of square, narrowing towards the north and with four brightish smaller stars further north still.

Capricornus, the Goat, contains no star beyond the 3rd magnitude, but a pair of two which come close together have somewhat the resemblance of horns.

Aquarius, the Water-carrier, is also far from striking, but can be found with no great difficulty by a cluster in it something like an incomplete W.

Pisces, the twelfth zodiacal constellation, is made up of a group shaped like a palm leaf, also a number of tiny lines of small stars seen only well on clear nights, continued as far south as Fomalhaut, in Pisces Australis, a brilliant 1st magnitude star shining as far as 30 S.

When we are acquainted with the zodiacal constellations and with the circumpolar ones it is not difficult to master the remaining principal groups in the heavens.

The chief constellations round the North Pole are: First the Great Bear, with it seven bright stars, two of which, called the Pointers, point direct to the pole, the Pole Star itself being in the tail of the Little Bear. At the opposite side of the Polar Star is Cassiopeia, forming a clear W, the W representing the chair on which she is sitting. The Dragon joins the two Bears. A little further south the brilliant stars Vega in Lyra, and Capella in Auriga, are nearly equi-distant from the pole, and are seen all the year round from Greenwich. If one is high towards the zenith the other will be low on the horizon, according to the season and hour of night.

In the southern hemisphere there is no star exactly at the pole, but the Southern Cross circles round it, containing two stars of the 1st magnitude and one of the 2nd, while the two brilliant pointers, Alpha and Beta, of the Centaur, make it easy to find. At one side of the Cross, even nearer the South Pole, is the Southern Triangle (Triangulum Australis), consisting of three stars equal in size, easily recognised. At the other side is the magnificent constellation of the Ship, Argo Navis, containing Canopus, one of the brightest stars in the heavens, as well as Eta Argus, which varies in brilliancy, reaching the 1st magnitude at its brightest.

Any constellation in the same position east and west, with one of the familiar zodiacal ones (having, that is, the same right ascension), will be visible when that zodiacal constellation is up in the heavens.

For instance, when the Gemini and Taurus are to be seen travelling across the sky, we may look for Orion (the Hunter) to the south with his companions, Canis Major and Canis Minor—the Greater and Lesser Dog.

This splendid group contains four 1st magnitude stars, Sirius, in Canis Major, being the brightest in the entire heavens, then come Procyon in Canis Minor, and Rigel and Betelgeuse in Orion. This group being south of the equator, the greater part is visible for a longer time in the southern hemisphere than in the northern.

Again, when Sagittarius, the Archer, has risen above the horizon we may look for Aquila, the Eagle, containing Altair, a star of 1st magnitude, and close to it the dear little cluster, the Dolphin. Also three 4th magnitude stars in a tiny line between Aquila, the Eagle, and Cygnus, the Swan, which represents Sagitta, the Arrow, presumably shot by the Archer towards these birds.

Lyra is close to Cygnus, and somewhat south-west of these constellations is the lovely little constellation of Corona, like a diadem in shape, formed by six stars, one very bright.

The Milky Way, a belt of innumerable tiny stars, appearing like a luminous track across the heavens, makes another clear mark for us to follow in the sky. In the southern heavens there are gaps of darkness in this luminous track known as the "Coal Sacks," and the Southern Cross is close to one of these gaps.

There are only about 20 1st magnitude stars.

1. Achernar in Eridanus.

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2. Aldebaran in Taurus.
3. Antares in Scorpio.
4. Altair in Aquila.
5. Arcturus in Bootes.
6. Alpha Centauri.
7. Alpha Crucis.
8. Beta Crucis.
9. Beta Centauri.
10. Betelgeuse in Orion.
11. Canopus in Argo.
12. Capella in Auriga.
13. Eta (variable) in Argo.
14. Fomalhaut in Pisces Australis.
15. Procyon in Canis Minor.
16. Regulus in Leo.
17. Rigel in Orion.
18. Sirius in Canis Major.
19. Spica in Virgo.
20. Vega in Lyra.

When we have mastered the chief constellations and are acquainted with all the 1st magnitude stars, if we see a bright star where no star should be we may conclude that it is a planet.

Most almanacks give the dates when planets are visible and in which constellation—always a zodiacal one—they are to be found. There are eight planets, not counting the small ones, between Mars and Jupiter. These eight are in the following order as regards the sun—each has its accompanying "character," which is marked in the almanacks:—

Mercury, ☿; **Venus,** ♀; **The Earth,** ♁; **Mars,** ♂; **Jupiter,** ♃; **Saturn,** ♄; **Uranus,** ♅; and Neptune, ♆.

Of these Uranus and Neptune are not visible to the naked eye, so, with the earth also deducted, there are only five planets which we can see.

Two of these, Mercury and Venus, are only visible as morning and evening stars, and Mercury, being so near the sun, is rarely to be seen at all.

When we see a planet rise in the east, travel across the sky at night, and set in the west, keeping the motion of the stars that we are acquainted with on the zodiacal line, even without the help of the almanack we know that it must be either Jupiter, Mars, or Saturn, and we can make a good guess by its appearance which of the three it is. Jupiter is much the brightest, Mars shines with a red glow, and Saturn has a light so much duller than the other planets that (together with its peculiar motion among the stars) it was thought by the Ancients to have an inauspicious influence.

The planets travel slowly, but quite perceptibly, among the constellations, changing their places relative to the fixed stars. These fixed stars, as we have seen, each appears to travel across the sky night after night, but keep their relative positions in regard to each other so as to form recognisable constellations. Whereas the planets are to be seen sometimes in one constellation and sometimes in another. Thence they originally received their name of "Planets," "Wanderers."

Besides the sun, moon, planets, and fixed stars, there are comets and meteorites, which visit our field of view, but their movements are, for the most part, beyond an amateur's calculation.

There are also star clusters and nebulæ, but these are hardly visible to the naked eye. Stars are of various colours--white, yellow, orange, and red.

These, when they are "doubled," have often blue, green, or violet companions. Double stars are not seen by the naked eye.

The principle 1st magnitude stars are *white*, amongst these come Sirius, Vega, Rigel, Altair, Regulus, and Fomalhaut. Our sun is a yellow star; also Capella, Arcturus, Aldebaran, and Pollux. The principle orange star is Antares in Scorpio; also Mira, the variable star in Cetus. There are no red stars of great importance. The white ones are in a state of glowing heat. The yellow are still intensely hot, but less so than the white, orange stars are cooling down, and the red are cooler still.

Some stars vary in brilliancy with different periods for their terms of change. The most renowned variable stars are, Algol in Perseus, having a period of 2 days, 20 hours, and 48 minutes. Mira in Cetus, called "Marvellous" on account of its change from brilliant orange-red to insignificance. At its brightest it is just visible to the naked eye. Its period is 11 months. Betelgeuse in Orion varies from the 1st to the 6th magnitude, and Eta Argus varies from the 1st to the 7th. At its brightest it rivals Sirius, which is the brightest in the heavens.

Several stars are called double stars, that is, have a companion revolving with them. Sirius has one so much smaller than himself that it may only be a satellite. Among other remarkable double stars are: A pair in Lyra, yellow and green; a pair in Orion, orange and blue; Rigel and companion, white and blue; a pair in Virgo, rose-coloured.

The earth, with the rest of the solar system, sun, moon, and planets, is hourly travelling at an incredible speed towards a remote point, at one time believed to be a small star in Hercules, but astronomers are discovering daily new revelations, and our destination is, I believe, not finally fixed. The solar system means our sun and all his belongings, whereas the expression "sidereal heavens" means the sphere of stars as distinct from our solar system.

Our sun, of course, is only one of the stars which adorn the wonderful Star Universe, of whose marvels new discoveries are hourly coming to light. But the heavens, as we see them with the naked eye, remain the same from generation to generation.

CORRESPONDENCE.

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—I am surprised to note in the August number of your excellent journal, a slurring remark cast at the Church of Rome by the author of the article entitled "The Motion of the Sun and Earth in the Universe." I refer to the note at the foot of the second column of page 286. The gentleman doubtless wishes to state that Copernicus, because he was a Roman ecclesiastic, feared that the authorities of the Church would condemn him because of his theories. That there is no foundation for such assertion may be learned from the facts that "De Revolutionibus" was dedicated to the reigning Pope, Paul III., and the expense of its publication was borne largely by Cardinal Cusa. Moreover, when the Copernican theory was broached in the oft-discussed Galileo affair, its author was always styled a "noble astrologer," this word having, at that time, no unworthy meaning.

Mr. Henkel should beware of innuendo. His purely gratuitous assertion is rendered still more unstable by his use of the term "probably." No very safe foundation, certainly, upon which to build a statement. Innuendoes are not manly, and, as a friend and sincere well-wisher of "KNOWLEDGE," I am sure my hope that no more of them will be permitted to appear in its pages will be fully realised.

Yours faithfully,
CHARLES C. CONROY, A.M.

Los Angeles, California,
August 12, 1909.

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MAP No. 11.

BRIGHTNESS.

- 1st Mag.
- 2nd ,,
- 3rd ,,
- 4th ,,
- 5th ,,
- 6th ,,
- Variable.
- Nebula.

MAP No. 11

Aquarius, Capricornus.

Star Map, No. II.

By Mrs. H. Periam Hawkins.

A small portion only of the constellation of Pegasus, the Flying Horse, is shown at the head of the map. The star *Epsilon*, Enif. (XXI. h. 39m. 9° 27′ S.) marks the snorting nostrils of the horse. In our northern latitudes this winged figure appears to be upside down.

Equuleus, the Little Horse, appears to be travelling in companionship with Pegasus. This small constellation is more truly an extension of Pegasus. *Alpha* and *Delta* are its chief stars.

The constellation of Aquarius, the Water Bearer, is the 11th Sign of the Zodiac. The stars *Pi*, *Zeta*, *Mu*, and *Gamma* form the vessel from which Aquarius is supposed to be pouring a never-failing supply of water into the mouth of the Southern Fish (*Piscis Australis*). The flowing water is represented by the long stream of stars to the south, including *Delta*, the star Skat, and the pretty curve of three stars numbered 86, 88, and 89.

Zeta Aquarii (XXII. h. 24m. 0° 32′ S.), the centre star in the "water-jar," is a long period binary.

The nebula, marked 2M. (XXI. h. 27m. 1° 19′ S.) is more truly a globular cluster or "ball of stars." It is difficult to realise that the suns which form this magnificent cluster, crowding as they do towards the centre, are probably as far distant from each other as our own sun is from the nearest star, a distance equal to 4¼ "light years," one light year alone being equal to a distance of 5,875,226,810,000 miles.

The *Aquarids*, meteors radiating from this constellation are visible from May 1-6, and from July 29-31. Mr. W. F. Denning, F.R.A.S. one of our first authorities, considers it probable that those of May 1-6 are connected with Halley's Comet, now on its return visit to the Solar System. (Mr. Denning reminds us, we may say in passing, that this comet will be only of the 12th magnitude in December and January next, and observable at that time in good telescopes only, therefore may possibly be invisible to the naked eye until April).

Capricornus, the Sea Goat, is the 10th Sign of the Zodiac. *Alpha* (or *Giedi* the Goat), the naked-eye double star, marks the left horn; *Beta*, another double star, is the right eye, while *Omega* represents the bended knee of the animal. *Delta* (XXI. h. 42m. 16° 32′ S.) is in the tail of the goat. *Rho* and *Pi* are also double, the companion stars in both cases being about 4″ apart. Number 30M, to the south, is a fine nebulous star cluster which may be seen with a small telescope. *Piscis Australis*, the Southern Fish, lies too low down in the south to be well seen in our latitude, but *Alpha Piscis* (XXII. h. 52m. 30° 6′ S.), or Fomalhaut, the Fish's Mouth, the chief star in the constellation, is a bright object on our southern horizon in September and October, being best seen during the latter month. It is the first star in the group of three mentioned by Dante in the "Inferno," viz., Fomalhaut, Canopus, and Achernar, to which he gave the names Faith, Hope, and Love.

A small portion only is seen of the constellation of Sagittarius, the Archer, on the right of the map. *Beta*, the naked-eye double star, marks one of the hind legs of the shooting Centuar, but this star is too far south to be seen in our latitude.

Grus, the Crane, with its long neck of stars, and the bright stars *Alpha*, *Beta*, *Gamma* and *Delta* which represent the body, is the most brilliant of all the modern constellations of the southern stars.

Reserve Force in Health and Disease.

By C. E. Lea, M.D., Vict.

Amid the plaudits of a thronging crowd, the Marathon runner enters the arena, struggles along the track, and breasts the tape, the hero of the hour. Though perhaps the slim figure of the runner contrasts apparently unfavourably beside the sturdy supporters who gather around him at the close of the race, yet is there little doubt but that the victor could, when fresh, run twenty miles with as little exertion as his supporters would require to jog, perhaps, two miles. So that one is led to enquire from whence has been derived this reserve strength, this muscular potential, which can, by dint of training and natural physique, be thus increased ten or twenty fold. And if such is possible for mere muscular effort, does this same extraordinary inherent capacity obtain for all the other vital functions of the body, functions which, unlike muscle, are beyond control of the will, automatic in their action? In this brief paper I hope to show how such logical queries can be emphatically answered in the affirmative, how comparatively valueless for the vital necessities of existence are the unessential, though more demonstrable, muscular elements, and how efficient and numerous are Nature's devices for preserving and maintaining, unseen and unfelt, the vital processes and their reserve strength, necessary for the ceaseless wear and tear of existence.

All active processes in the body are dependent for their continuance on the intake of nourishment and the removal of waste material. The result is protoplasmic activity, and this is associated with production of energy in the form of heat and work in varying proportions.

Such active processes are either: (1) Katabolic or breaking-down of tissues with corresponding discharge of energy, or (2) anabolic, a building up or conserving of energy. And it is the physiological balance of these two mutual but antagonistic processes which constitutes the life-force. The simplest form of katabolic discharge of energy is muscular effort. Here the energy is mainly expended outside the body in the form of force. It is obvious that this is energy lost to the body. There is excess of katabolism over anabolism. And since all muscular action is volitional, it follows that theoretically, at any rate, it is possible to continue this disturbance of normal equilibrium until life is no longer maintainable. In other words, we have the power (theoretically) of volitional self-dissolution. To discover whether this is possible, we can choose no more apt example than the Marathon race. Here is undoubtedly a great discharge of katabolic energy. But here, too, we see Nature's wise precautions against such a disaster as self-dissolution in two striking ways. First, there is, what I hope to show below, the great power of reserve force capable, by suitable methods, of being drawn upon to an extraordinary degree; and, second, when such reserve force has been exhausted, there is Nature's final check, namely, loss of consciousness, whereby the muscles can no longer be urged forward by the master brain, and the balance of metabolic activities are thereby once more restored.

To show how the latter result naturally follows upon the former it is necessary to enquire into the sources from whence energy is derived, the order in which they

are drawn upon, and the final effect of such katabolic activities upon the anabolic functions, which are mainly carried on by the more vital organs.

Still confining attention to muscular activity, increased reserve force is obtained in five ways: (1) Growth; (2) Training and Effort; (3) Distribution of Labour; (4) Inhibition Reflex; (5) Protective Mechanisms.

(1) *Growth.*—Reserve force in muscle, as in all tissues, depends primarily on its quantity and quality. Growth as a physiological phenomenon is common to all tissues, but it varies considerably in capacity and rate in different tissues. It is impossible for anyone ever to develop all their muscles to their fullest capacity, though, of all tissues in the body, muscle fibre is perhaps the most capable of development. Whilst an adult brain, for instance, is only about double its size at birth, the muscular system is many times its weight at birth. Moreover, this growth of muscle varies at different age periods. Its maximum capacity for growth is in early youth and adolescence. A similar amount of exercise, for example, undertaken by a youth and a full-grown man will produce greater muscular increase in the former. For two reasons this is a wise provision of Nature. First, the feeble muscular development of the infant at birth, as compared with the lower animals, necessitates a correspondingly increased rate of growth; and, second, that in man's primitive condition, at any rate, his existence depended on his power of katabolic activity or force externally directed. When the athlete begins his training then, we will presume he has ordinarily well-developed muscles. By dint of exercise he may increase his muscular powers for a given act to its maximum capacity. That is to say, he draws upon his first source of reserve force—power of growth. He then carries to a further stage his capacities by means of

(2) *Use and Effort.*—I would distinguish these by the qualification that the latter implies will-power directed to action in the same way as the psychologist distinguishes continued thought from mere reverie.

Let x = a man's power of running before undertaking any training for the purpose, and y = the amount of force necessary to win a race. Then y-x = extra amount of work or reserve force required. Suppose that by training he raises his muscular power to its maximum capacity z; z-x will represent this increase due to power of growth, and y-z represent the amount of force still required to win the race. It will be obvious that the greater the value of z the less additional y-z required, that is, the less added effort necessary.

It is this z-y which decides the race. To perform this z-y it is necessary to make effort, to spur on the muscles by the will. It is common knowledge that will-power directed to muscular action increases the power of the latter. This fact is made use of by Sandow in his injunctions to his pupils to concentrate the mind upon the actions performed. It is this added nervous element, essential for effort, which makes the man leap a wall when pursued by the proverbial mad bull, a feat he would be totally unable to perform without the necessary nervous stimulus, in this case supplied by fear. It is this z-y interval which must be nursed so carefully by the coach, for if the will is overtaxed ever so little the athlete becomes stale; in other words, his will-power for a given action is unconsciously lessened.

The second added factor in effort then is nervous. How this factor may be developed to become increasingly capable of prolonged effort may be stated briefly. The first effect of continuously directed muscular effort is that the neuro-muscular co-ordination is improved. That is to say, the nervous channels, which conduct cerebral impulses to the particular muscles, become increasingly capable of transmitting the stimuli with each repetition of the act. Actions at first performed under the stimulus of will require, with increased frequency of performance, less and less will-power, and become increasingly automatic, and thus the will-power is increasingly conserved. No more apt example of this conservation of nerve power applied to muscular effort can be afforded than the acquired act of walking. Long ago with most of us it has become purely an automatic act. Thought is no longer necessary to enact each complicated set of movements, the nervous energy required for them having been delegated to the lower nervous centres situated mainly in the cord. Thus is the brain conserved for higher things. Just as the maximum muscular development z lessens the total z-y effort required for a given act or series of acts, so the increased neuro-muscular co-ordination lessens the amount of will-power required. Whilst in the case of the latter mechanism the result of increased neuro-muscular co-ordination causes increased power of action, automatically performed, that is, independent of any sum of effort, and thus conserving the will-power, so also muscular development lessens the amount of effort required. The two processes are mutual, and their efficiency is evidenced by the extraordinary powers of sustained effort which, by scientific training, can be thus obtainable.

The amount of force y, therefore, required to win the race depends first upon the capacity for muscular growth x, and then upon the amount of effort or will-power which can be brought to bear upon the particular muscles. As has been shown, in a severe trial of strength, the muscles tired, the brain fatigued, volitional self-dissolution is prevented by loss of consciousness. We see that the chief factors concerned in katabolic activity externally directed are muscular and nervous. But these are not the only sources of energy involved.

(3) *Distribution of Labour.*—It is a common experience after a long walk followed by a day or two of stiffness that this stiffness is not always confined to the muscles which we imagine are mainly concerned in walking. As a matter of fact, nearly every muscle in the body has been concerned in varying degrees in the act.

The labour is distributed over as large an area as possible. Every organ, anabolic and katabolic in function, responds more or less to the increased oxygenation of the tissues produced by exercise and aids in lessening to some extent the strain involved were all the force required obtained from one source only.

(4) *Inhibition Reflex.*—This is a very interesting and striking phenomenon, researches on which are still quite recent and by no means completed. As a device for preserving nervous energy for automatic functions its value is only just being fully appreciated. To understand this conserving mechanism it must be understood that all muscles of the body, even when not in use, are in a partially contracted condition. They are in a state of tonus. This implies a certain nervous control continuously applied. In the extended leg, for example, both the muscles on the front and back of the thigh are slightly contracted.

But when the knee is flexed two antagonistic conditions of the respective muscles must occur. The extensor muscles must be completely relaxed and the flexor muscles must be contracted. Now the inhibition will consist in the nervous energy, expended in thus contracting the flexor muscles to a greater extent than their normal condition of tonus, being augmented by the smaller fraction of nervous energy which had been applied to its antagonistic extensor muscles in their condition of tonus, and which, on the latter's complete relaxation, is no longer required. This fraction of nervous energy thus transferred for the moment from the extensor to the flexor groups of muscles in this particular instance thus conserves the total output of nervous energy otherwise necessary. Nearly all the muscles of the body are arranged on this mutual, yet antagonistic, system, and thus it will be seen how considerable is the saving to the nervous mechanism by such a simple device.

(5) *Protective Mechanisms.*—It has been shown that for great katabolic activities loss of consciousness forms an ultimate safeguard, whilst for smaller actions loss of will-power for that particular action checks a too damaging exhaustion. Volitional effort is thus safeguarded. But it is when we come to examine the involuntary tissues, all the more vital organs, tissues essential to existence, and which functionate independently of any whim or fancy of the ego; it is in these tissues that we find protective mechanisms most wonderfully developed. The mere fact of such vital processes being placed beyond one's own control is in itself a safeguard not easy to underestimate, and since anabolic processes are more essential for existence than any katabolic processes, it is these structures, the heart, lungs, kidneys, liver, and so on, which are most efficiently guarded.

Effect of Katabolic upon Anabolic Activities.—If the pulse of the Marathon runner be examined at the close of the race it will no doubt be considerably accelerated. The heart may be beating 120 or even 140 to the minute. But it would be going at that rate after the first mile of the race, and after but a few minutes rest the heart would be resuming nearly its normal frequency. The physiologist would find that the pressure of the blood in the arteries after the enormous strain is not markedly increased, and it, too, would soon sink to its accustomed level. There has not been a very great effect, then, upon the circulatory system. The respirations are not more than double their normal frequency and normal equilibrium here is soon restored. The chief seats of exhaustion we find are the muscular and nervous elements. But in what proportion? The limbs perhaps refuse to move another step. But if an electrical stimulus be applied to them, the muscles respond with a fairly vigorous contraction. They are not *per se* exhausted. Physiologists have proved that the slender nerves, the channels along which the necessary stimuli from the brain to the muscles are propagated, are tireless. By a process of exclusion, therefore, we are driven to the conclusion that of the two elements, muscular and nervous, principally involved, it is the latter, the brain itself, which is the main seat of exhaustion. The fact that loss of consciousness ensues in the last extreme, as well as the well-recognised preceding signs of mental exhaustion often noticeable in any great trial of strength, bear out fully the physiological facts here mentioned. Finally, it must be noted that the chief anabolic processes are to an extraordinary degree capable of responding to their requirements and are not affected to the extent one would imagine would be the case by even so severe a katabolic discharge of energy as a Marathon race.

Reserve Force and Disease.—In the reaction of reserve force to disease it is those anabolic processes which are chiefly concerned. Just as has been shown in the case of the Marathon runner, that excessive katabolic discharge of energy has not a great deal of effect on the anabolic processes, conversely, in conditions calling forth considerable anabolic or life-sustaining activities, and such conditions pre-eminently prevail in the struggle against disease, katabolic functions or mere muscular development aid very little in these conservative processes.

The first most obvious source of reserve force in the viscera is to be found in the apparent excess of tissue over the amount normally required to fulfil its particular function. This applies to all organs of the body. It is estimated, for instance, that life is quite compatible with but one-twelfth of the amount of lung tissue we normally have. One kidney, it has been repeatedly shown surgically, is quite enough to fulfil the usual excretory functions; yet we have two. Again, nothing is more striking to the pathologist than the extensive disease which may prevail in the heart muscle and yet for years it may support life. The spleen, that great manufacturing organ in the body for the red and white corpuscles of the blood, has been frequently removed from the body, with no untoward results, its functions being capably fulfilled by the lymphatic glands and the marrow of the bones. Similarly, large portions of the intestine have been removed with no diminution in the subject's capacity for ingesting nourishment, and extensive injuries of even so vital an organ as the brain have been followed by no permanent ill-effects.

These are striking facts. Again, for the efficient performance of function, all tissues of the body require a liberal blood supply. This is brought about by nervous automatic control of the calibre of the blood-vessels, which allows a more liberal supply of blood to the tissue actively engaged. Whilst such a mechanism applies to the muscular system alike as elsewhere, it is in the viscera that this nervous control of blood supply is carried to the greatest extent.

How do such organs react in disease? Perhaps the simplest form of disease we could take is

Starvation.—Here is successive and continuous wasting of tissues. There is excess of katabolic over anabolic activities. The body is feeding upon its own substance. Loss of weight is continuous and gradual. Emaciation follows upon absorption of all superfluous fat, the first element to go, and weakness ensues upon the rapid diminution in size of the muscles. Note that these two tissues are the least indispensable to life. It is not till a large percentage of the muscular tissue is absorbed that the ceaseless auto-nutrition begins to absorb the more vital structures, but death ensues, in fact, long before any appreciable loss of weight occurs in the brain or heart. It is found that whereas the muscles at death have lost 42.2 per cent. of their normal weight, the brain has lost only .2 per cent., and the heart 0.0 per cent. (Voit). The amount of weight lost by different tissues is thus in inverse ratio to their importance in the maintenance of the vital functions. When we come to consider specific diseases, we find that, as in starvation, there is disturbance of varying degrees in the metabolic activities of the body.

XUM

These disturbances are in all cases produced by intoxication, though the effects vary widely according to the quantity and quality of such poisoning, and the tissues mainly affected. Intoxication is produced either by deleterious products manufactured in the body, as in the febrile disturbances or the latter stages of organic disease, or the body may be poisoned by products introduced from without. Of the latter class no better example for the purpose of showing the body's reaction can be shown than the train of symptoms following alcoholic intoxication in its acute form. Here is illustrated in its clearest form what is called the "Law of Dissolution," which declares that, under a general excitant such as alcohol, it is the last acquired faculties which are the first to be stimulated and then destroyed; in other words, successive functions are destroyed in inverse ratio to their development in the individual.

The last faculties acquired by the adult individual are judgment and reasoning. Under alcohol these are the first to go. Self-consciousness quickly follows, and the subject is either unduly hilarious or stupidly dull. Sight becomes obscured. Speech is affected usually about the same time as gait, both early acquired faculties. Finally, in the "blind, paralytic" stage, there is complete loss of all voluntary control, diminished power of involuntary functions, and, should a fatal dose of alcohol have been taken, the circulatory and respiratory functions, the earliest of all vital functions, are scotched, and death results. Thus are the successive hostages devoured by the arch-enemy of intoxication. The vital functions are preserved as long as there is a single unessential function still capable of standing between them and the enemy.

That such a fatal issue is not more frequent is due to two other counter-checks of Nature, provided against voluntary intoxication. The first is the gastric reflex, which produces vomiting if too severely irritated by the poison; whilst the second is the loss of consciousness, which forbids the subject imbibing more than a certain amount. In comparing this rather extreme example of intoxication with the effects of starvation, one is at once struck by the general similarity of method by which the body reacts to the unusual conditions. In both the unessential faculties or tissues are sacrificed at the expense of the more vital functions, and in both it is only when such have been offered up that the vital organs themselves yield to the enemy at the gate.

Though most body intoxications are less severe and of longer duration than these examples, the tissue reaction is much the same. Only recently, in fact, has it been discovered how numerous and effective are Nature's protective agents against the attacks of disease, in addition to the "gradation of hostages," above mentioned. Tuberculosis, for instance, is an intoxication produced by the products of bacterial action. These may circulate in the blood from a focus frequently situated in the lungs, or they may remain localised, prevented by vigorous tissue reaction or "inflammation" from entering the system, as in the case of a tubercular knee or hip. In these cases we are protected by no stomach reflex, as in the case of the intoxicant introduced from without. Nor does loss of consciousness prevent the extraordinary multiplication of the germs. Our only protection is the general condition of the system, but here again pathologists and bacteriologists have discovered still other protective mechanisms; other vast stores of reserve forces, namely, the power of the body to manufacture antitoxins to combat the bacterial toxins. Whereas it is possible to prepare artificial antitoxins which may have a bactericidal effect when injected in proper amount into the body, it is becoming increasingly recognised how great are the powers of the body itself to manufacture in enormous quantities the particular antitoxins most efficient for combating the invading germs, and the greater the vitality of the body, the better the general health, the more power has the body to perform this protective function.

What other sources of reserve force are at our disposal and yet undiscovered it is impossible to say. Day by day are being revealed to us the wonderful reserve forces, the whole powers of which we are yet but dimly conscious, but without which life and the whole realms of existence itself would pass away from us for ever.

Recent Dew-pond Literature.

By EDWARD A. MARTIN, F.G.S.

IN speaking of dew-ponds as the water supply of the numerous encampments which are found on the chalk downs, Mr. A. H. Allcroft rightly points out in his "Earthwork of England" the absence of any necessity for such supply in the case of the hill-systems of the west and north of England, since these never lack abundant springs, but the upper levels of Wilts, Dorset, and Sussex are almost entirely waterless. It is only where the chalk forms the soil or subsoil that any special arrangement came to be necessary; of springs there are practically none, except at the foot of the hills, for the porous chalk greedily swallows up all the rain as it falls. Hence it has been firmly established that the only source of water which would be available for the upland earthworks of England lay in open reservoirs of water in the shape of ponds. The evidence on which this statement is based need not be gone into here. Mr. Allcroft rightly says that in many cases these ponds stand on the actual crests of the high ground, but he also says "they can catch no rain-water save what inconsiderable quantity falls actually into their basins." A calculation of the area of a pond at its normal level, and the area of the margin which serves as its catchment-area will show that the actual pond-area is frequently doubled, and sometimes even trebled or quadrupled. We can scarcely call the rain which falls thereon inconsiderable. Dr. Hugh Robert Mill states in *Symons' Meteorological Magazine* that with an average rainfall of 35 inches for the highest parts of the South Downs, and taking into consideration the difference between the collecting and evaporating areas "the depth of water in a pond which has once been filled should increase" sufficiently to supply the demand of many sheep, and this supposing that the area of the margin is equal only to that of the water-surface. The rainfall area is in this case double the evaporation area, and as Mr. J. Hopkinson has pointed out, every inch of rain would add, if we grant his premises, two inches of water to the pond. If it were not for evaporation and the drought of cattle, such ponds should overflow. The fact remains that such ponds do not overflow, and, what is more, they never seem to rise above a certain level. If rain alone were the cause, or principal cause, of replenishment, they should, as it seems to me, at times be much more full than they ever are, since, as I have shown, a depression in the surface of the soil will draw a greater amount of rain into it than falls on the surface of the downs around. Much of the area of the margin, too, absorbs all the rain that falls on to it, being imperfectly puddled

and full of cracks. Besides, the rainfall is too irregularly distributed throughout the year to prevent a pond wholly dependent on rainfall from frequently drying up.

Dr. Mill makes the suggestion that the reason why the ponds at low levels run dry is probably largely due to the fact that they have not been so carefully puddled and rendered watertight, and partly, perhaps, owing to their greater use for farmyard purposes. From both of these reasons I fear I must dissent. Leaving aside ponds which are fed by brooks, I see no reason to suppose that farmers take less care in puddling their artificially-made ponds, when these are, as a matter of fact, often their sole water supply, and the use made of them would not, I imagine, equal the use made of upland ponds by flocks of sheep numbering five or six hundred head.

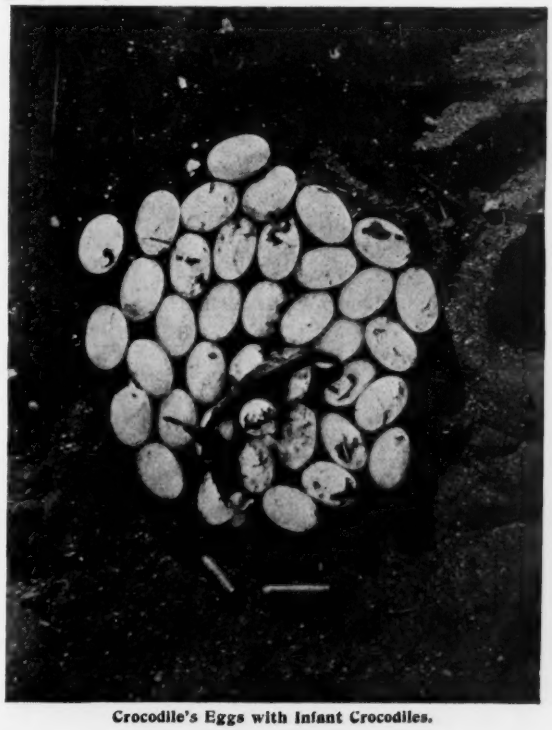
Mr. Allcroft says that the upland ponds "draw their supply almost exclusively from the air." This is a very definite statement, and cannot be altogether accepted, as we must, at any rate, allow that rain has a good deal to do with the supply. "They make their own supply by condensation, and the greater the surface area of the pond, the more rapidly does the work of condensation proceed." Also "that the activity of a dew-pond in collecting water is in direct ratio to the extent of surface." This must mean, if it means anything, that water begets water, and that as a commencement a pond must be fed by rain, or otherwise filled artificially, and when once filled it ought never to run dry. "While they can borrow moisture from the atmosphere under almost any conditions, it is from mist and fog that they derive it most readily." That this may be so I admit. A great quantity of water may be so derived, but how it comes about we are not informed. Mr. Allcroft says that in the winter the basin fills to the brim with water. I have never yet seen one filled to the brim, and such an infilling never, I believe, happens. Mr. Allcroft's description of the construction of a dew-pond follows exactly that of Mr. Hubbard, but, as I have shown in a previous article, there are other forms of construction. And although he adopts the particular plan of a straw layer resting on chalk, and covered by puddled clay, and then by rubble or loose flints, he has nothing to do with the "thermodynamics" of Mr. Hubbard, but states that "the lining of straw, being elastic, prevents cracking. The whole is an application of the principle to be seen in a thrush's nest," the object being "to secure greater elasticity and toughness." In a thrush's nest the puddle, if I may so call it, certainly rests on the twigs and grasses, but I am under the impression that the first object of this is in order to make a foundation for the dried mud, for there is no foundation otherwise than the atmosphere, whereas in making a pond there is the chalk bed to rely on. Secondly, the grasses protect the clay from too much evaporation, for the cracking of the clay which would follow its desiccation would be fatal to the whole structure. I take it, too, that the clay prevents the conduction of heat from the eggs or chicks, and so conserves the heat bestowed in a downward direction by the sitting mother. Puddled clay has good radiating, but very low conducting, powers. If the conduction of heat were not thus prevented, the mother-bird might sit in vain, and as we know that vegetable matter is a good radiator, it must be the mud or clay which prevents the passage of the heat, the grasses acting as a foundation to prevent cracking, as a binding material for the clay, and as a means of keeping the clay of the nest moist. Anyone who has observed an old nest in a museum must have noticed how dry and cracked such has become, after being kept under a roof for a short time.

Mr. Allcroft's idea is that the straw used under a pond is a contrivance to preserve the elasticity of the clay, and in order to accomplish this the straw must be kept dry for it to respond to the elasticity of the clay. I do not think, however, that it is yet shown that Mr. Hubbard's theory is disproved, and if we are to credit the alleged rise of a pond by 3½ inches after five nights of heavy dew, as stated by Mr. Allcroft, I cannot help thinking that there must be some secret in the construction of the pond in question, the locality of which is not stated, in order to account for it. After watching a number of ponds in Sussex for some months I have not met such phenomenal increases, although Mr. Hubbard has recently stated that all the Sussex ponds are built with the straw under the clay. I am afraid, however, that his statement is too sweeping, and I know that some Sussex ponds were not so built, for example, some on the Norfolk Downs, and two at least near to Chanctonbury Ring.

In a recent discussion before the Society of Arts, Mr. W. K. Stratton mentioned some ponds in the Colesberg District (Cape Colony) whose surface, without any drainage, and in the dry season, and in the absence of springs, was higher in the morning than in the evening. This is a most interesting statement. It is scarcely to be expected, I imagine, that these ponds were constructed with any special dew-attracting bed, and further information is desirable.

A Crocodile's Nest.

THROUGH the kindness of Mr. G. W. Grabham, of Khartoum, we are able to publish a photograph of the eggs of a crocodile's nest. The size of the eggs as well as that of the two small crocodiles, one of them lying across the eggs, and another emerging, can be apprehended by reference to the cartridge which is photographed by their side.



Crocodile's Eggs with Infant Crocodiles.

An Examination of the Volcanic Ash of Mont Pelee.

By ALBERT B. MIDDLETON.

THE writer recently had handed to him from a most reliable source (the material having been personally collected on the island of Martinique, West Indies, during a voyage) some of the volcanic ash from Mont Pelée, the eruption of which, it will be remembered, utterly wiped out of existence the adjacent town of St. Pierre, with its 30,000 inhabitants.

Curious to know whether such a deep-seated disturbance as the one in question had resulted in the expulsion of volcanic material of an unusual nature from a lower depth than ordinary (for this problem of the unexplored inner crust is ever with the geologist), the writer thought that a series of investigations upon this ejected matter, produced during one of the most catastrophic convulsions in the history of volcanology, might possibly bring to light some out-of-the-way features of composition, and the results of the research are given below.

Of course, in undertaking this, it was fully recognised that the material in question had not been collected in such a manner as would yield a representative sample, viz., by selecting small average portions over as large an area as possible, but it must be borne in mind that the ordinary methods of sampling which obtain in analytical work would in any case have proved inadequate in view of the colossal nature of the outburst, seeing that tons and tons of the impalpable dust were carried in the upper air hundreds of miles away from the scene of the disaster. In this connection, for example, it may be mentioned that dust from Krakatoa was found floating all over the earth for three years after the great eruption.

From the commencement it was assumed that the present constitution of the ash might probably vary very considerably from its original composition, as the molten magma is stated by some authorities to be at a temperature of 2,000° F., even at the moment of its expulsion from the crater, and in case there had been an excess of elements in combination, readily volatilisable at low temperatures, then those not existing as silicates, or in other forms which would persist even at high temperatures, would naturally be gasified, and would, consequently, not be found in a subsequent analysis.

To get some preliminary idea as to the relative proportions of the main constituents, various tests were applied, flame, blowpipe, and qualitative chemical tests, and spectroscopic and microscopic examinations were also called into requisition, the final results being obtained by quantitative chemical analysis.

It speedily became evident from the chemical tests that none but the ordinary metals usually found in such materials were present to any extent, a search for such metals as copper, lead, silver, chromium, bismuth, and others being unsuccessful. A slight trace of manganese was noticed, and a quantitative analysis for nickel and barium, which were originally suspected of being present, proved both these latter elements to be absent

For the spectroscopic examination a portion of the scoria was dissolved in hydrochloric acid, and evaporated to dryness, in order to separate the silica ; on redissolving, the silicious residue was filtered off, and the resultant chlorides transferred to a Mitscherlich tube; fed therefrom into the flame of a Bunsen burner, and examined through an ordinary direct vision instrument.

This revealed the alpha lines of calcium, which element was found by separate analysis to be present as CaO to the extent of some 7 per cent.

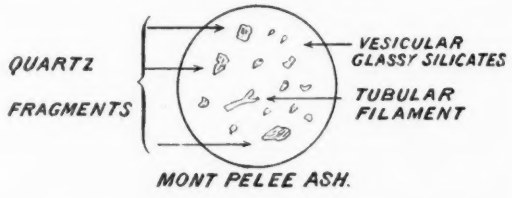
No other indication of any importance was observed by this method, the non-appearance of the alkalies being probably due to the fact that the insoluble residue, in which these are often in combination, was filtered off.

Another portion of the ash was examined through a petrological microscope, in conjunction with a polariscope, under about 150 magnifications.

This showed that the great bulk of the material was composed of the unindividualised glassy silicates usually observable in such cases, with an occasional crystal here and there, the brilliant appearance of which, under the crossed Nicols, indicated them to be quartz. The particles were highly vesicular, some being drawn out into the characteristic tubular form, thus betraying the manner of their origin. No magnetite was noticeable.

As commonly found in materials of this nature, the sudden cooling of the magma at the moment of expulsion had prevented anything like a crystalline structure obtaining throughout the mass.

A sample of ash from Cotopaxi, collected from Chimborazo, 65 miles distant, by the celebrated mountaineer, Whymper, was examined side by side with the above, and presented a very similar appearance, save that the particles were nothing like so vesicular.



MONT PELEE ASH.

It appeared increasingly evident, therefore, that the ash was one quite of the ordinary type. The ground having thus been cleared, a quantitative analysis was next undertaken.

A portion of the gritty grey dust was triturated, passed through a 90 mesh sieve, and was then ignited in order to normalise it with regard to hygroscopic moisture, and to bring it in line with the conditions obtaining at the moment of expulsion.

The analysis was proceeded with as in the case of an ordinary acid refractory material, until the silica was separated, after which the subsequent processes were dealt with as in an iron ore.

The results obtained are given in round figures as under :—

Silica (SiO_2)	57
Alumina (Al_2O_3)	21
Oxide of Iron (Fe O)	7
Lime (CaO)	7
Magnesia (MgO)	3
Alkalies (xNa_2O y K_2O) ...	say 5 to balance

It will be seen from this, therefore, that the ash, far from presenting any features of an extraordinary nature, practically corresponds in composition to an ordinary intermediate igneous rock, the ultimate constitution of a typical sample of which is here given for purposes of comparison :—

Silica	60
Alumina	15
Alkalis	6
Alkaline Earths	10
Oxides of Iron and Manganese	9

Birds on the Black List.

By W. P. Pycraft.

The number of birds which at one time or another have been outlawed, put upon the Black List, as injurious to man's welfare on account of damage done by them to either animal or plant life which he is desirous of protecting, is great. And in every single case there have been not a few who have protested against such proscription; and generally these champions have much of right on their side. The damage done is often more imaginary than real, and in many cases, where actual damage is beyond dispute, this injury is more than compensated for by benefits conferred at other times and in other ways. But there seems to be at least one case where no extenuating circumstances can be pleaded, and this is furnished by the Kea Parrot (*Nestor notabilis*) of New Zealand.

For many years this bird has been under a cloud, and this because it has been repeatedly accused of killing sheep in the attempt to get at the kidneys thereof! The indictment seemed incredible, and for a long while many refused to believe that it could have any foundation in fact, or, at any rate, that the source of such injuries must be sought for in another quarter, since a parrot could hardly be the culprit. And this scepticism was strengthened by the contradictory nature of the evidence, for among those most qualified to speak—the sheep-farmers themselves—some declared that they had suffered not at all, while others complained bitterly of the losses they had sustained. It is now apparent that both were right, for the Kea haunts only the sub-alpine regions of the Island, ascending still higher in the summer, and descending to the forest region in the winter. Thus only flocks within this zone were damaged.

These facts and the evidence of the mischief done, backed up by much gathered from personal investigation, have just been set forth, lucidly and dispassionately, in a small volume by Mr. G. R. Marriner (Williams and Norgate). Herein he passes in review both the life-history of this most interesting bird and the nature and extent of its depredations, clearing up much of a controversial character in regard to both of these aspects, and thereby he has done ornithologists a real service, for he has brought together a mass of new and valuable data.

As to its habits he shows that the common opinion that this bird is restricted to the alpine regions is incorrect. For although it is a mountain dweller and ranges into the snow-covered area, it haunts, during the greater part of the year, the sub-alpine areas and the forests. Yet it is not by any means a tree-dweller, preferring to pick up a living on the ground or around the rocks. Some, however, at any rate, contrive to pass the winter at high altitudes, living a kind of subterranean life under the snow. The ground, it must be remarked, in these regions is covered with low, thick scrub, forming a roof on which the snow can lie and stiff enough to bear the weight of it. Beneath this roof the Keas find both warmth and food, and here they seem to remain till "the flowers appear on the earth and the time of the singing of birds is come." And this fact is all the more interesting because the Spitzbergen Ptarmigan, and Red Grouse in Scotland, adopt on occasion a similar device.

One of the Brush-tongued Parrots, this bird, as might be supposed, is primarily a vegetarian and a honey-eater. But insects and their larvæ, and worms form no small part of the daily rations. And in this love of animal food we have a possible explanation of the unfortunate raptorial instincts which this bird has developed. Many explanations, it must be remarked, have been put forward to account for this. A very plausible one was that suggested some years ago, to wit, that large mammals being hitherto absent in New Zealand these birds mistook the woolly backs of the sheep for the huge masses of a remarkable flowering plant (*Haastia pulvinaria* and *H. sinclarii*) which forms huge woolly-looking masses as large as, or larger than, the body of a sheep. Delving in these masses the birds were supposed to find an abundance of insect food. Seeing that the herdsmen themselves are said to be deceived by the likeness of these plants to sheep, it was but natural the birds should be similarly mistaken, and thus, tearing away the wool, they soon got down to the luscious flesh, and the rest of the descent was easy! But a more probable explanation is that given by the author of this book. Driven down by stress of weather during the severity of winter, these birds, on reaching the lower levels, would "come across the meat gallows, where very likely carcases of sheep would hang, or,

Female. *Male.*

Keas' Heads: Showing the external differences between the sexes.

at least, some skins with pieces of meat and fat still adhering to them would be thrown over the fence to dry.

"In trying everything with its powerful beak to see if it were edible, it would soon taste the pieces on the skins or even from the carcase itself, and, finding them much to its taste and easily procurable, it would soon acquire a liking for them.

"If the skins and carcases were absent there would always be a number of sheep's heads scattered around the gallows, and the Keas could there always find something to eat.

"It is said that, in the early days, miners prospecting for gold often killed a sheep for food, and, roughly skinning it, would leave the skin and much offal on the ground, thus giving the Kea ample opportunity to get a taste for meat.

"Once having acquired the carnivorous taste, it would soon find out that the dead sheep lying about the station contained the same kind of food, and that by tearing off the wool a good meal was always to be had. Tearing at a half-dead sheep buried in the snow would be the next step on the downward course, and, finding a lack of dead sheep, it would soon begin to eat the animal while it was running about. The wounds thus caused would soon mortify and cause the animal's

death, and so the Kea would find an ever accessible method of acquiring a meal."

That this explanation is the correct one seems highly probable. Certainly serious injury is, or was, inflicted on the flock-master where these birds abounded, and terrible suffering on the sheep. For animals were often found with yards of gut dried and trailing on the ground behind them, which had been pulled out through a hole in the flank, generally on the right side. In some cases the wound had healed, the opening of the gut, grafting itself to the edges of the hole in the flank, forming a false anus!

Since substantial rewards have been offered for the heads of the birds, however, their numbers have been greatly reduced. Mr. Marriner even regards their absolute extinction as probable, and, being a keen naturalist, suggests that before this melancholy fate overtakes them a few pairs should be turned down in the Aucklands, which lie 190 miles south-by-west of the mainland, where there seems to be enough forest and high country to make a satisfactory reserve.

if the birds had killed for the lust of killing. But, according to some accounts, the losses of the flock-masters were enormous, so as absolutely to bring ruin in their train. But Mr. Marriner insists that these lurid stories of ruin have absolutely no foundation in fact. "At any rate, not a particle of evidence can be found to-day in support of these wild tales."

This extraordinary history is but another illustration of the results of man's interference with the balance of Nature, though the consequences here are the reverse of what usually obtains. That is to say, the animals introduced into a new country by man have generally inflicted severe loss and even extermination on more or fewer of the native fauna. Here man's action has been to pervert a bird which had hitherto led a blameless life, bringing, incidentally, upon himself, serious loss!

There are not many cases of changed habits so striking as this afforded by the Kea, but strangely enough South Africa has produced a parallel. This is furnished by the Rhinoceros bird (*Buphaga erythrorhynchus*), a small Passerine which, in times

A Kea: On the Ball Glacier.

A Sheep Killed by Keas. A Merino Ram found on Top Flat, Mt. Algidus Station.

There are two further points worth noting in this most interesting account. In the first place it is not the kidneys or the kidney-fat that these birds seek, as has been stated by nearly every writer who has discussed this subject. The fact that the loins are generally the only part attacked is easily explained by the fact that this is the easiest point of attack. Secondly, all Keas are not addicted to this unfortunate habit, and had this been known earlier and only the offenders had been killed this habit would have been speedily stopped. Kestrels are commonly and ignorantly branded by gamekeepers as pests. Occasionally one will make off with a sacred bird, and if the marauder be promptly shot a dozen may haunt the same spot without hurt to the game. Keas appear usually to confine their attacks to certain districts, and when the birds have all been shot off the hunting may cease for years. The slaughter appears generally to be done by a number of birds—seven or eight—acting in concert. As a rule, even where Keas are abundant, their depredations do not exceed five per cent. of the flocks, but occasionally this percentage has risen considerably, as

past, obtained much of its food in the shape of ticks and other parasites infesting the hides of rhinoceroses and buffalo. The introduced domesticated horses and cattle received a like attention, but being relatively thin-skinned the bird soon drew blood, and, finding this more to its taste than leathery ticks, has in some parts of the East African Protectorate become a source of danger to stock-owners, who accordingly, through the Commissioner of the Protectorate, Sir C. Eliot, petitioned the Government to remove the bird from the protected list on which it had been placed.

Here, as in the case of the Kea, we have an illustration of changed habits due to man's interference with the balance of Nature—albeit a justifiable interference.

In many cases, indeed in most cases, where man takes it upon himself to settle the question of the harmfulness, or otherwise, of any given animal to his personal welfare or profit, he acts entirely on hasty and crudely formed judgments. The farmer, the fisherman, and the game-preserver alike have each, in turn, given abundant evidence of this. They sneer at any systematic attempt to get at the truth of the matter,

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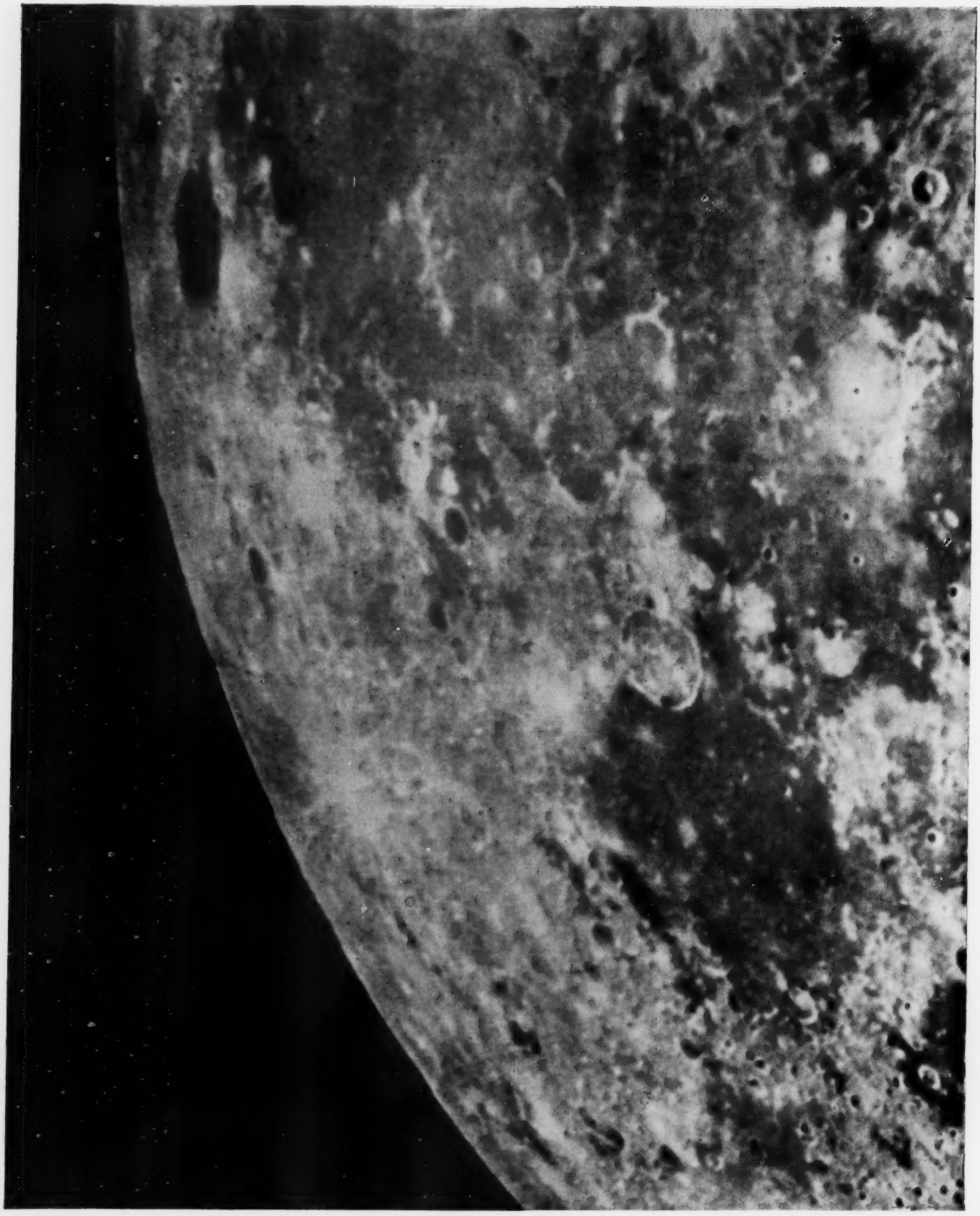

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The Moon.

and loftily and contemptuously dub the scientist a "mere faddist," thereby displaying a depth of stupidity pitiful to contemplate. It has been for generations, and, unhappily, still is, the fashion to sneer at science in this country, and hence the superiority of our neighbours the Germans, who long ago learned to appreciate the value of exact knowledge as a guiding principle of their lives.

We might cite many instances of the mischief that has been done by this attitude, but one shall suffice; and this is furnished by the action of would-be legislators in Australia in regard to the Cormorants of the Murray River and the swamps and neighbouring lakes thereof. These birds still nest in this region in hundreds, but time was when they massed in thousands. But fishermen and anglers, casting envious eyes on these imaginary rivals, started a war of extermination, only to find, to their chagrin, that the supply of fish decreased with the destruction of the Cormorants, whereas the opposite results were expected to follow!

Then the investigation, which should have been set afoot before the war was declared, was begun, and it was soon found that these Cormorants were feeding, not upon fish, but upon crabs, eels, and lampreys and young turtles, all of which had been attracted, like vultures to a carcase, by the enormous quantities of fish spawn deposited in the shallow waters of this area!! As the Cormorants were being slowly reduced in numbers these enemies to the spawn were increasing, and at a prodigious rate, so that the harm done is almost incalculable.

It was, and is, commonly supposed that fish form the only prey of the Cormorant. The "mere scientist" knows better, and knows, furthermore, the stupidity of following tradition in this respect. A little scientific caution would have saved an appalling amount of slaughter and a rich harvest of fish. But it will be many years before the Murray River regains the losses which this folly has brought with it.

Photograph of the Moon.

THE portion represented is the E. and E.S.E. region of the lunar limb, and some of the formations are not very clearly outlined, the sun being high above them and the shadows gone.

The *Mare Humorum* is that large, irregular, dark patch on the lower part of the plate. It is about 280 miles in diameter and exhibits a greenish tint; the borders are grey. There are a number of craters with other detail on the floor, and these may be beautifully seen as the sun rises and sets upon them.

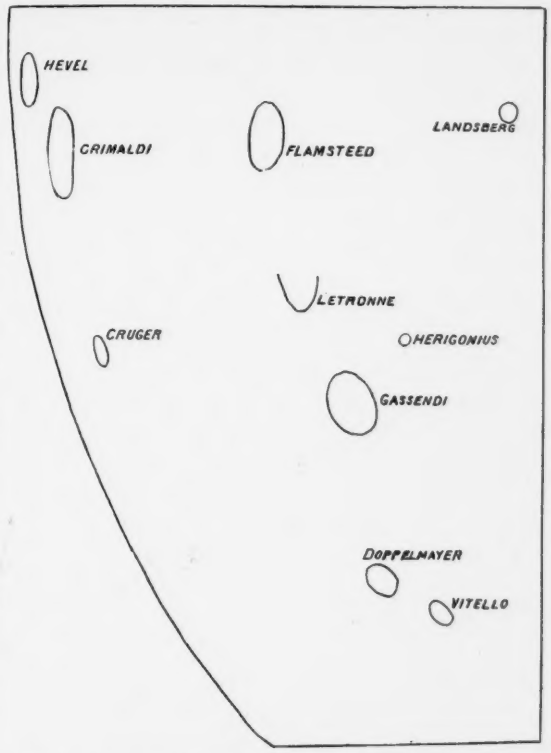
Vitello lies on its S. side, and is rather a remarkable feature as having a lofty central hill which overtops the entire outlying wall.

Gassendi stands on the N. side of the Mare Humorum, and is one of the most attractive features on the moon. It forms a large walled plain about 55 miles in diameter, containing a mass of interesting detail. Among its clefts is one of a curious triangular form. Many drawings of this feature have been made as a result of special study, and for these see *Ast. Reg.*, Journal L.A.S., *Eng. Mech.* (Sept. 17, 1909, p. 162). Dr. Klein, of Cologne, published a drawing in *Sirius* for 1890 of Gassendi, and gave a full description of its scenery (*Observatory*, XIII., p. 86). Observe this object when the moon is about 12 days old. Schroter suspected that real changes were affecting this feature.

Lansberg is nearly 30 miles in diameter, and its ring is lofty, ascending almost to 10,000 feet in one region. The upper side of the plate shows the dusky surface of the Oceanus Procellarum.

Flamsteed is a large crater with a low wall not averaging more than 320 feet in height (Webb).

Grimaldi, near the margin, is nearly 150 miles long and 130 miles in width, and is noteworthy for its strikingly dark interior. It has been occasionally perceived without any optical aid. Gruithuisen, who was rather given to romancing among the lunar features, thought he discerned a regular construction there similar to the capital letter H inclined.



Hevel and *Riccioli* lie close to Grimaldi. Hevel forms one of the walled plains about 70 miles across, and includes a straight ridge, also a minute crater which Schroter, on insufficient evidence, considered to be new.

Riccioli is nearly as dark as Grimaldi, and is closer to the moon's margin. Its lofty and extensive ring is beautifully displayed in the rays of the rising or setting sun. The effect of libration appreciably affects the aspect of objects lying so adjacent to the periphery, and variations occur which an observer might well consider real.

The map includes many other prominent formations of various types, and all of them exhibiting some points of interest.

BIRKBECK COLLEGE.—We have received a copy of the Calendar and Prospectus for the Session 1909-10 of this well-known College, giving full particulars of the day and evening classes held there. Among the subjects in which tuition is given by recognised teachers of the University of London for degrees in Science, Arts, and Economics are Chemistry, Physics, Botany, Zoology, Geology, Mathematics (pure and applied), Literature, Languages, Classics, Geography, History, Logic, Economics, and British Constitution; while instruction is also provided in Assaying, Metallurgy, and Mining. The scientific subjects receive complete attention from both the theoretical and practical sides, there being well-equipped laboratories for the latter. The fees in all cases are very moderate.

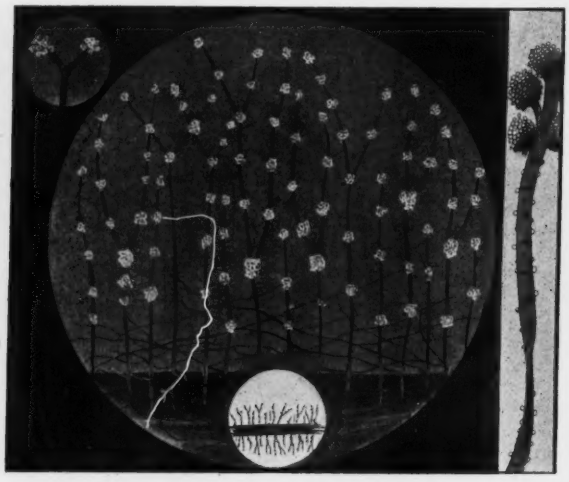
XUM

Microscopic Tree-Fungi.

By JAMES SCOTT.

THE great hindrance to the study of the microscopic fungi is their objectionable character to the naked eye and their frequently obnoxious odours. A piece of rotting twig, cabbage stalk, or some comestible may carry immense quantities of exceptionally interesting fungi, but there is little persuasion towards studying them when it is found necessary to handle the beastly stuff. Moreover, another disadvantage that tends to keep fungi in the background is that, owing to their universally delicate structure—a mere touch is often sufficient to demolish a symmetrical group—they cannot all be purchased as mounted specimens on microscopical slides.

The following examples of microscopic tree-fungi are grouped together because they were all obtained at the same time from the same pieces of twig, etc. In addition to picturing the fungi as nearly natural-size as possible in the smaller circles, it may be advisable to



No. 1.
Botrytis Cinerea.
The bunch spray fungus, magnified. Shown on a sixpence proportionately. A small branch is more magnified in the right-hand space; while the upper left-hand circle shows a pin-hole proportion of the growth.

regard the circles as enlarged pinholes, Nos. 3, 5, 6, and 8, representing those made with the point, and Nos. 1, 4, 9, 10, and 12 with the shaft of a 1½ in. pin. In other words, the first circles are with a ¼-in. objective, and the second ones with a ½-in. objective.

The genus, of which *Botrytis cinerea* is a good example, has several representatives that are parasitic on garden and farm vegetation. This particular specimen has simply branched, dark olive stalks, along which ashy, or grey, bunches of spores are arranged as shown in No. 1. The style of secondary branching by which the spores adhere to the stalks can be understood by referring to the right-hand space of the figure.

The coral spot fungi (No. 2) are great pests to the fruit grower. They are, in themselves, very pretty objects, and dot the stems and trunks with bright red, densely scattered warts like small seeds. There is a great similarity between the various species, and the typical genus depicted in the figure may be regarded as representing them all. In their first stages they are bright coloured, and discharge their spores irregularly; but in their second stages they become rather dull in tint, and the spores are arranged in pear-shaped *perithecia* clustered together. In reality, a *nectria* splits gradually into these *perithecia*. A hole in the summit of each of the latter allows for the liberation of the spores. The majority of forest trees are open to the attacks of these compact fungi.

One of the most delicate kinds of fungi is that displayed in No. 3. Fairly long, slender, unbranched stalks support at their summits either one, two, three,

No. 2.
A Common "Nectria."
Coral pear fungus; each mass being about the size of a pin's head.

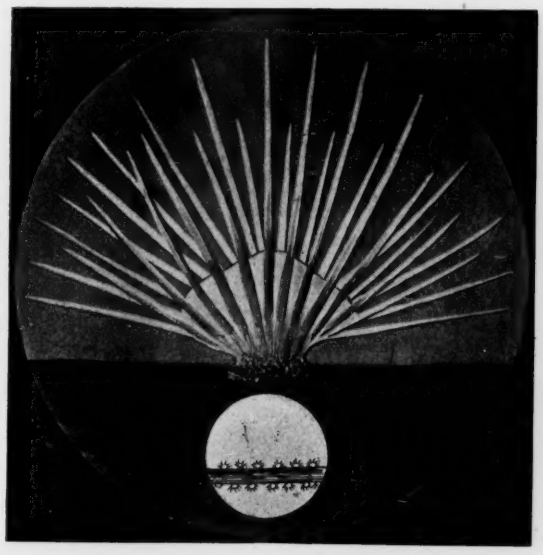
No. 3.
Trichothecium Obovatum.
The frail-bead fungus, magnified. About life-size in the small circle.

four, five, or six individually divided spores. Usually the number is three. The spores are jerked off, when ripe, by the corkscrewing of the stalks. To the naked eye this fungus appears as scattered white, glistening patches, each patch composing what, in reality, is a miniature thicket. This specimen is *Trichothecium obovatum*.

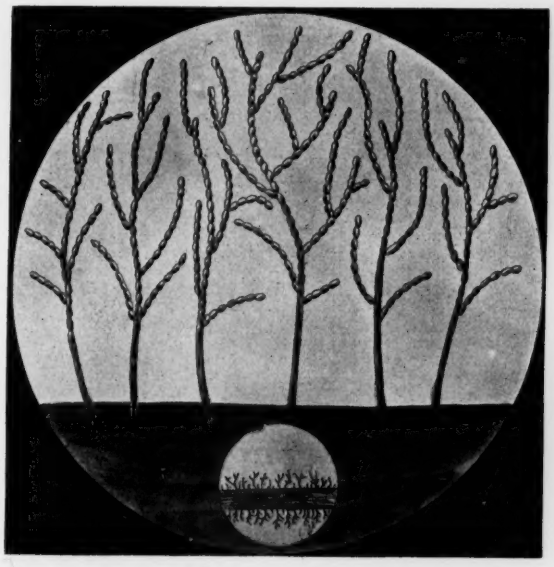
Another very different style of white fungus is the *Volutella ciliata*, in No. 4. To the unaided sight it might, on account of its mealy appearance, be mistaken for the last-mentioned example, though no experienced microscopist would be thus deceived. The

whole dot is really a spore-case, and is strongly defended against the attacks of mites by numerous stiff bayonet-like projections pointing in all directions.

The group of which the present *Torula pulveracea* (No. 5) is a good example may be appropriately called necklace fungi. The transparent spores are set end to end in tree-like tufts, as shown. Of course, each spore is capable of setting up a whole *mycelium* bed on its own account in a suitable *nidus*, and so it gains over many more elaborately contrived fungi in that it is practically all seed, so to speak.

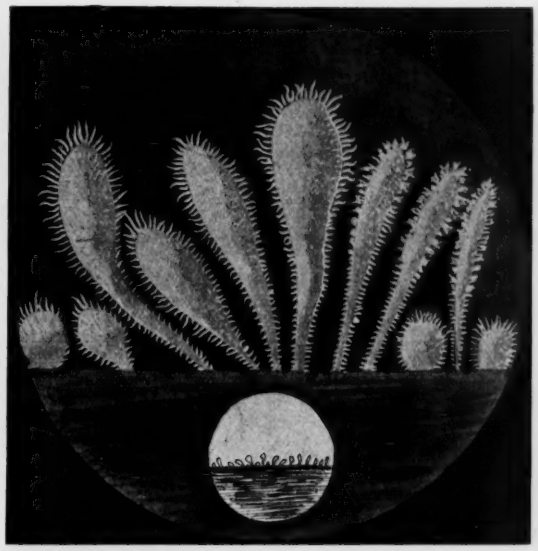


No. 4.
Volutella Ciliata.
The spring-knob fungus, magnified. Compared also with a sixpence.



No. 5.
Torula Pulveracea.
The necklace fungus, magnified. About life-size in the small circle, which proportionately represents a sixpence.

The *Pistillaria* are club-shaped fungi, strikingly resembling the *Clavaria*. Indeed, the chief differences are those of size, the first being minute, and the second of much larger dimensions. *Pistillaria puberula*, which I picture in No. 6, has a powdery white sporophore, or club. One member of this genus, *P. micaus*, is a beautiful glossy, rose-coloured object that is most charming under the microscope.

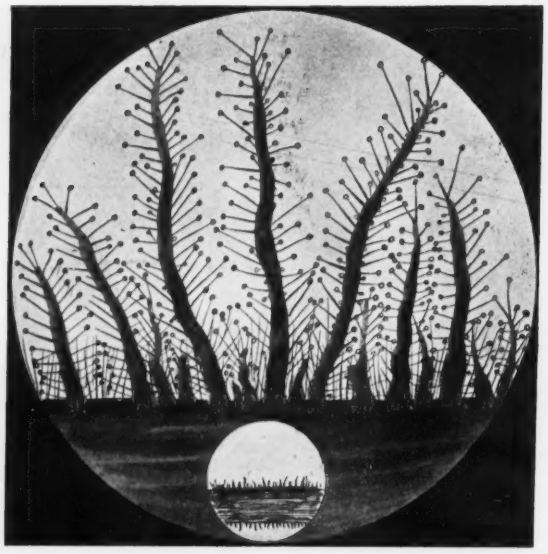


No. 6.
Pistillaria Puberella.
The prickly-club fungus, magnified. Shown life-size on a sixpence.

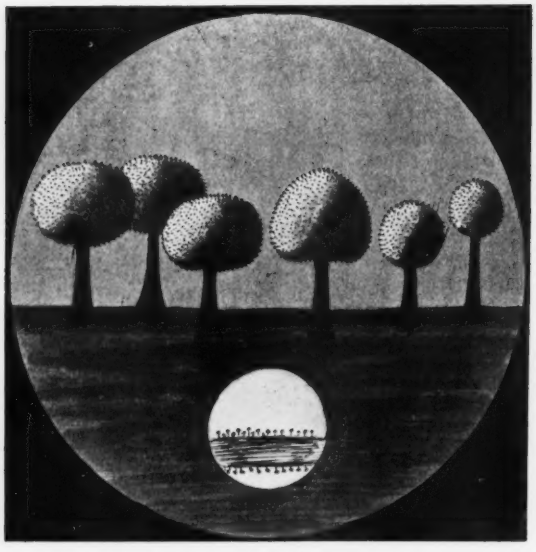
No. 7.
Outgrowths due to Mites.
The ribbon snake fungus, magnified, and about life-size on a sixpence.

The specimens that I exhibit in No. 7 are so widely classed as fungi by naturalists and are so common that a few words should be given concerning them. They

appear like tiny collections of twisted faintly golden, or pale brown, hair emanating from scattered parts of the wood. When moistened, they wriggle about like a nest of serpents, and liberate dust which apparently consists of spores; yet Mr. W. B. Grove, a mycologist of much experience, tells me that they are simply outgrowths due to the attacks of mites.



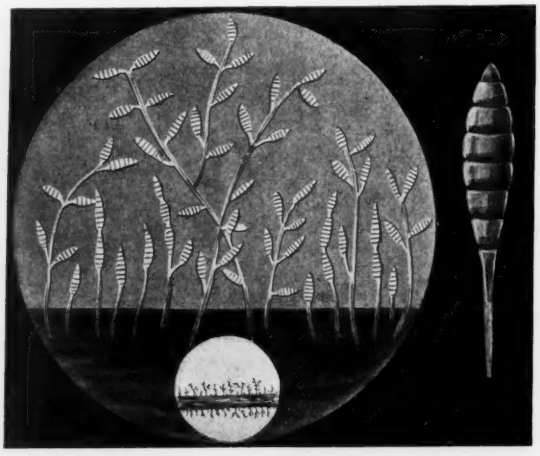
No. 8.
A Species of Isaria.
The tiny pin fungus, magnified. Shown life-size on a sixpence.



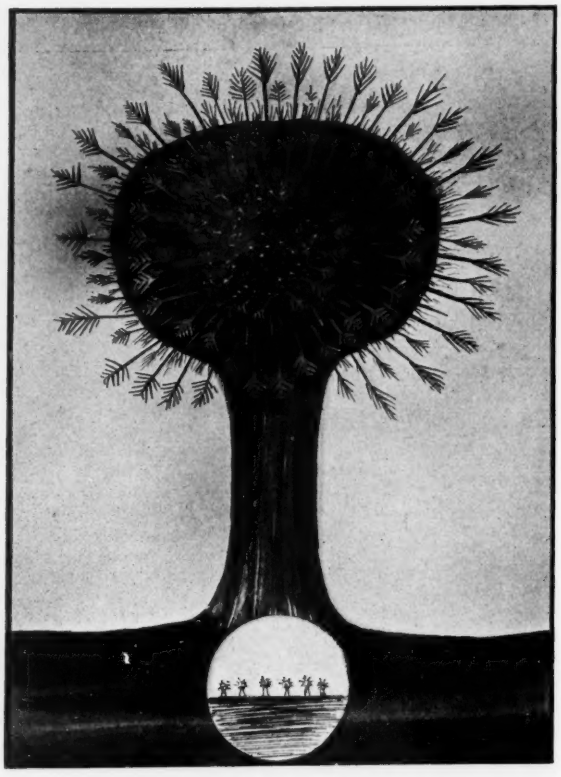
No. 9.
Common Myxomycetes.
The stalked globe fungus, magnified. Shown life-size on a sixpence.

The genus *Isaria* are minute prickly or mealy fungi, as can be seen by referring to No. 8. Rough projections get thickly covered with variously directed stiff, pin-like objects, the heads of which are the spores. Colour is the chief distinguishing feature of this genus, and it is not necessary to go further into their usually simple structure.

The *Myxomycetes* are, by many of the advanced cryptogamists, considered as quite distinct from the



No. 10.
A Species of Dendryphium.
The divided-gem fungus, magnified. Compared also with a sixpence. To the right is shown, more highly magnified, one of the gems, or spores.



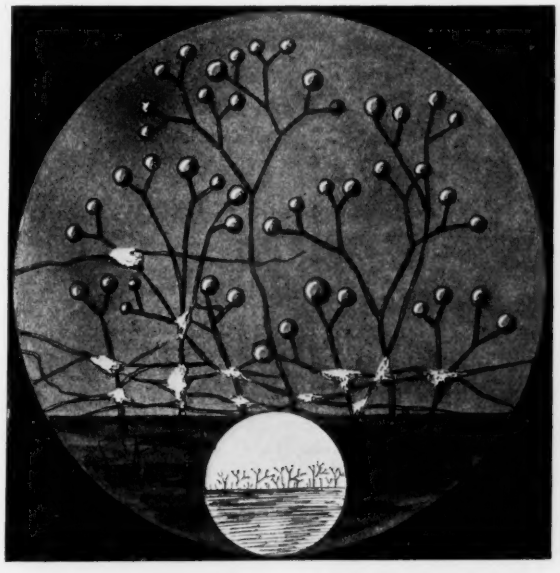
No. 11.
A Myxomycete covered with a Parasite.
The bristle-fan fungus, magnified. Shown about life-size on the sixpence.

true fungi. In the present instance, however, it will not be a very perfidious act if I regard them as belonging to the subject, in conformity with the opinions of older naturalists. No. 9 is an example having either

dark brown or black stalks and fluffy, golbular heads of a greyish or whitish tint. No. 11 depicts another specimen covered with a parasitic fungus allied to the *Penicillium*, or blue moulds.

A *Dendryphium* is given in No. 10, in which the transparent spores are pale green when flattened between slips, but appear very dark previously. The particular style of the genus can be gathered by noting the method of growth and the positions of the divided spores, one of which is magnified to greater proportions at the side of the circle.

A rather curious Y-branched fungus is the *Sporodinia dichotoma*. The pearl-like spore-heads occupy the extreme tips of the rusty brown plant, as a rule, but frequently at the bases another form of reproduction, often to be encountered also in the *Mucorini*, or pin-fungi, comes into operation. Two or more spore-cases meet together, and ultimately coalesce, the *gametes*, as they are then called, forming a single, strong spore-cell. Sometimes one is apt to confound two or more



No. 12.
Sporodinia Dichotoma.
The pearl fungus. Compared with a sixpence.

species of fungi together when observing these stages, as they twine together like the bushes and plants of a hedgerow.

Everyone of these examples came from trees, having grown chiefly on the thinner stems and twigs. Odd broken pieces of dead trees stood in water within large glass-covered jars and left undisturbed for some days will almost surely develop many of these fungi, but it may be necessary to hunt about for some species.

The *mycelia*, or hidden threads, send up aerial stalks, or *hyphæ*, on which the varying characteristic fruits are carried.

When I examine the fungi I merely hold the stem beneath the microscope and revolve it gradually so as to bring all its circumference into the field of view. Of course, this causes the outside to appear as a horizon, from which protrude the fungi in an undisturbed condition. Some species can be transferred, with a needle, to a slide, though this plan needs great carefulness. A drop of water on the slide, into which *some* specimens are dropped, will assist their definition.

Photography: Pure and Applied.

By Chapman Jones, F.I.C., F.C.S., &c.

Exhibitions. The annual exhibition of the Photographic Salon at the Gallery of the Royal Society of Painters in Water Colours, 5a, Pall Mall East, opened on the 10th, and the annual exhibition of the Royal Photographic Society at the New Gallery, 121, Regent Street, on the 23rd of last month. As usual, the former is devoted exclusively to pictorial work, while the latter includes every branch of photography. I cannot refer further to the Society's Exhibition as this page goes to press before it is open. Of the Photographic Salon, the most striking feature is the absence of colour photographs, although last year they had a very large number of autochromes. This must surely mean that the foremost exponents of pictorial photography find that the modern colour photography is not in accord with what the "forewords" of their catalogue refer to as the "artistic temperament," and either that they have given up the method as useless, or that they are striving to adapt it to their purposes, and have not yet sufficiently mastered it to show their results. At this Gallery the student will be able to see the effects of variations in many matters of detail. Sharpness of definition ranges from what is entitled to be called sharpness to a want of it that is so extreme that one cannot tell the character of the subject portrayed. The pictures range from a whiteness that is hardly entitled to be called bright, to a darkness that in some cases does merit the description of gloom. And in like manner the tone and the modelling vary from almost absolute flatness to a richness that most of us may well envy the ability to produce. It is satisfactory to note that some of the richest results are by workers who practise straightforward photography by purely photographic methods, such as Furley Lewis, E. O. Hoppe, Frederick H. Evans, and J. Craig Annan, though exception may well be taken to some of the exhibits of the last two named. This exhibition would be of much more use to the student, whether his inclinations lead him towards the scientific or the pictorial side of the art, if the evident reluctance to say what the various pictures are, or, in general, the method of their production, could be overcome.

Plates for Colour Photography. The colour-screen method of photography, first rendered practical by Messrs. Lumière when they issued their autochrome plates, continues to advance. It should be clearly understood that there is room for progress in both the manufacture and the use of such plates, because at their very best they can never claim absoluteness in the reproduction of colour; the result must always remain a compromise, and subject, more or less, to the skill of the worker. But the same may be said of the reproduction or, more strictly speaking, the copying of colour by any practical method, whether by hand painting or the more mechanical processes of chromo-lithography, or any of the three-colour photographic processes. These colour plates, therefore, merit the very serious attention of all who wish to photograph coloured objects in colour, and, as a matter of fact, they are being used in the various branches of biological work. During the last year or so the treatment of the autochrome plate has been considerably simplified

XUM

and the price of them reduced, and the Thames plate and the Omicolore plate have been put upon the market. Of these, the Thames plate is a thoroughly British product. The hopes expressed in the reference to it last January are now fulfilled, and it is issued as a single plate as well as with the colour-screen and the sensitive film on separate plates. This last arrangement has some possible advantages perhaps with regard to the multiplication of copies of a given subject, but the single plate method must always be more free from uncertainty and more definite in its results. It is satisfactory, therefore, that the Thames plate is now obtainable as a single plate complete in itself, at the usual price of three shillings for four quarter-plates, and in other sizes at proportionate prices.

A Test for Phosphorus.

Luigi Sabbatani suggests that unoxidised phosphorus may be detected by means of a gelatino-bromide plate. The material to be examined may be placed on the plate for ten minutes and then washed off, or the plate may be placed over the material so that the vapour given off from it acts on the plate for an hour or so, or the air expired by a poisoned animal may be allowed to impinge upon the plate, and then the plate is developed and fixed as usual. The phosphorus renders the silver salt developable. Of course, this is not a specific test for phosphorus, as other substances, such as sulphuretted hydrogen and hydrogen peroxide, will produce a similar result. The chief value of the suggestion is, I think, not as a test for phosphorus, but as a reminder that plates are very sensitive to its fumes.

Vigorous Ensyna.

The vigorous variety of "Ensyna," with its three kinds of surface, "glossy," "matt," and "carbon," gives excellent results from negatives that are too thin for ordinary printing papers. It requires from eight to sixteen times the exposure suitable for the ordinary "Ensyna," and develops rather faster. In the other details of its manipulation and the variety of colours that can be obtained with it, it is very similar to the ordinary "Ensyna" that has been previously described. The vigorous image that it gives makes the best of negatives that are unduly thin, but as the more prolonged exposure necessary to get the more reddish-brown colours tends to give a rather flatter image, these vigorous papers will doubtless be found useful when warmer colours are desired with negatives that give an ordinary range of contrast.

Notices.

Messrs. Wellington and Ward announce an "'Xtra speedy plate," which they claim to be of exceptional rapidity. Messrs. Elliott and Sons announce a 'Barnet Super Speed" orthochromatic plate, for which they claim a sensitiveness of 400 H and D.

Messrs. Burroughs Wellcome and Co. will send free on application tables printed conveniently on cards (1) times for development with various developers at temperatures from 45° F. to 70° F.; (2) factors for factorial development and equivalent plate speed numbers of B. W. and Co.'s indicator, Watkins, and Wynne; (3) formulæ for various colours on lantern slides by development; (4) the relative speeds of bromide papers and lantern plates. The first three refer to "tabloid" preparations.

The Paget Prize Plate Co. announce the "Paget Phosphate Lantern Plate," which gives any coloured image from blue black to sepia with the same developer. They are similar to the "Phosphate" paper referred to last month.

Messrs. Merck, of Darmstadt, who are noted for the excellence of their preparations, supply pyrogallic acid crystallised by a new process in compact crystals, which occupy about one-twentieth the bulk of an equal weight of the more usual feathery crystals. It is convenient to use, and gives results that are all that can be desired.

Solar Disturbances During August, 1909.

By FRANK C. DENNETT.

THE disturbances during August have been fair in number, but not of great magnitude. At noon on August 1 the longitude of the central meridian was 290° 35′.

Nos. 74 and 75 are repeated from last month's chart as they remained visible until August 3 and 4 respectively.

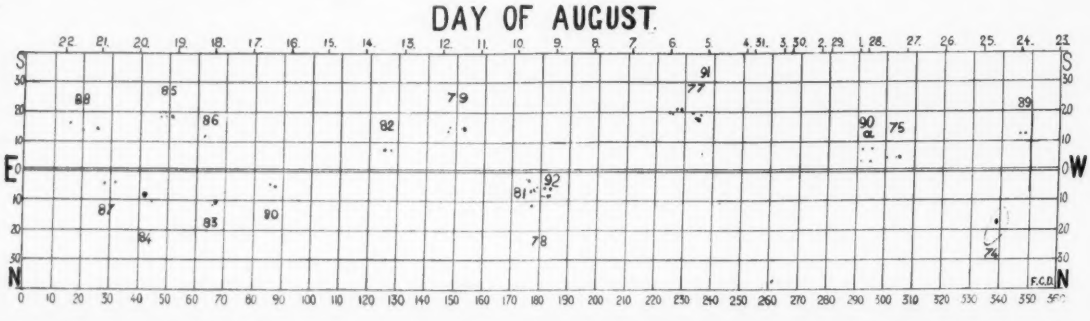
No. 77.—A group of small spots and pores 80,000 miles in length, with its leader only 7,000 miles in diameter. Considerable change took place among the members, but the general form of the group remained until 8th. Only one or two pores seen 9th and 10th in a very faculic region.

No. 78.—A spotlet glimpsed in a faculic area on 3rd, two 30,000 miles apart 4th and 5th, but on 6th and 7th, when last seen, only the eastern one remained.

No. 79.—Minute pores on 9th, increased 10th to 12th, its leader becoming 7,000 miles in diameter and the length of the group 43,000 miles. On 13th only the leader was seen, it was more elongated, and contained four umbræ, but rapidly decreased, being last seen on 15th.

No. 80.—A pore 11th, a solitary spotlet 12th and 13th, and only two pores 14th and 15th.

No. 81.—A very compact group of two or three pores only seen 12th.



No. 82.—A little group of pores on 12th enlarging during the day, but on 13th only a solitary one remained.

No. 83.—A very faculic region containing a small spot on 13th, which next day had a tiny companion east, a nearer companion on 15th, only one pore seen on 16th. As this spot came round the eastern limb bright metallic prominences were visible.

No. 84.—Another spot, 11,000 miles in diameter, in a very brilliant district on 14th. Some pores were around it on 19th, but otherwise it was solitary until last seen on 23rd.

No. 85.—A disturbance consisting of about three pores opened on 15th, the eastern spot largest 17th, but on 18th, when its length reached 30,000 miles, the western was the largest; it had decreased by 19th, but one pore remained until 21st.

No. 86.—A single pore, only seen 19th.

No. 87.—Two pores, 18,000 miles apart, only visible on 22nd.

No. 88.—A group of spotlets in faculic surroundings showed on 25th, and were last seen close to west limb on 27th, 80,000 miles in length.

No. 89.—Two pores, 15,000 miles apart, only visible 26th.

No. 90.—A pore on 29th, a group 22,000 miles in length 30th, then died out.

No. 90*a*.—First seen as a solitary pore at noon on 30th, by the evening two elongated pores 22,000 miles apart, which remained visible until 31st.

No. 91.—A pair of pores first seen on 28th in a faculic district marking the site of No. 77, remaining until 30th.

No. 92.—A group of small spots and pores showed on 31st in the place formerly occupied by No. 81, reaching a total length, on September 2, of 60,000 miles, but then dwindled so that from 5th until 7th, when last seen, only grey pores remained. The group was active, but its members were small.

The chart is constructed from the combined observations of Messrs. J. McHarg, A. A. Buss, E. E. Peacock, and the writer.

The Tudor Hospital at Croydon.

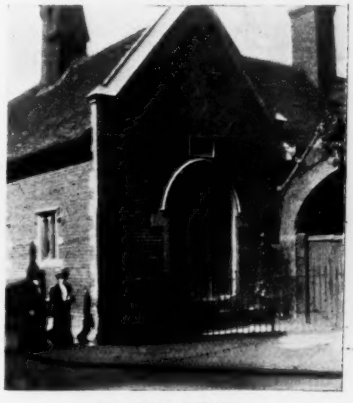
The Whitgift Hospital, Croydon, is a plain unpretentious building so far as the outside is concerned. The building was commenced in 1596, and was finished in Whitgift's life-time, as he did not wish, as he informed Stowe, to be "a cause of their damnation" to his executors. In the course of street improvements, its demolition is threatened, and our readers may be interested to see the building from its various aspects. It is built of red brick, with stone facings. It has retained almost the whole of its original doors, benches, tables, and fittings. The original panelling surrounds the old dining-hall, and some of the old glass still remains, and many antique documents are in possession of the Warden. The quadrangle is an oasis of quietness and resembles very closely the collegiate style in vogue in Tudor days.

E. A. M.

Whitgift's Hospital: Looking North.

Looking East along George Street.

Looking West; the chapel is at the nearest point.



The Chapel Gable.

Inside the Quadrangle.

Inside the Quadrangle.

NOTES.

ASTRONOMY.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S., F.R.A.S.

LOWELL OBSERVATORY 40-INCH REFLECTOR.—Just as the 60-inch reflector of the Mount Wilson Solar Observatory has been satisfactorily completed and brought into working order, it is announced that another mirror of large aperture (40 inches) is almost completed by the Alvan Clark Company for Professor Percival Lowell, at Flagstaff, Arizona. The mirror is to be thicker than usual to avoid flexure, and the focal length decided upon is 18 feet 4 inches. A special feature in the mounting of the mirror is the provision of a series of zinc blocks between the iron supporting ring and the edge of the mirror, the relative proportions being so designed as to avoid strain on the glass with changes of temperature. The mounting will be of the so-called English form, the two ends of the polar axis resting on concrete pillars adjusted in a north and south line; the polar axis itself will be in the form of a rectangular frame inside which the telescope tube swings on trunnions. All the driving mechanism will be operated by electric motors, one for the actual following, and another for slow motion.

The working programme projected for the new instrument includes planetary photography, and region photography of the nebulæ and stars. When arranged for planetary work, secondary mirrors are to be provided which will transform the instrument into a Cassegrainian reflector of either 154 feet or 75 feet focal length. For photographing nebulæ and stars a plane mirror will be used as secondary, giving the images at the principal focus. It is with some reason hoped that the specially good atmospheric conditions which have favoured past work on Mars will enable the full value of the 40-inch aperture to be realised.—(*Observatory*, August, 1909.)

SOLAR VORTICES AND MAGNETIC FIELDS.—Professor G. E. Hale has given some suggestions in explanation of the peculiar vortical structure shown on the spectroheliograms obtained at Mount Wilson, in which the terrestrial analogy of atmospheric phenomena is tentatively shown to be applicable in many respects. At the outset, however, certain important differences between the constitution of the solar and terrestrial atmospheres must be taken into account. The principal of these is that the temperature of the solar vapours appears to be practically uniform from the equator to the poles, and this would suggest that there would be no considerable convection currents produced like those of the earth, and this agrees with the fact that up to the present no evidence has been found on the photographs of the solar surface showing stream lines.

From time to time careful observers have noted that indications of whirling motion were seen in sun-spot areas, but it cannot be said that sun-spots in general present sufficiently definite characteristics to formulate a theory based on their similarity to terrestrial atmospheric tornadoes. However, a great mass of information has been accumulated which shows that similar appearances are to be detected in the spectra of spots to those presented by light sources in the laboratory when subjected to a magnetic field. Many of these phenomena have already been noted in detail as they were published. Concerning the question of the interaction of these magnetic fields in the solar atmosphere on the terrestrial atmosphere, and the production of magnetic storms, it appears that, although a close relationship undoubtedly exists between the phenomena, the solar phenomena cannot be the direct cause of the latter. There appears to be some reason for believing that the more extensive eruptions associated with sun-spots may be the cause of terrestrial magnetic storms, but a considerable amount of research is still requisite to obtain the necessary evidence.

VISIBILITY OF STARS IN DAYLIGHT.—M. Salet, of the Paris Observatory, has during the past year been investigating the possibility of devising observing modifications whereby faint stars can be measured in full daylight. Many years ago the late Professor Cornu demonstrated experimentally that blue skylight is strongly polarised; in pure air the proportion may attain as high a value as 80 per cent. Of course, this only applies to the diffused or scattered light which is simply sunlight reflected from the air particles. On the contrary, starlight, being intrinsic radiation proceeding direct from the celestial bodies outside our atmosphere altogether, is not polarised. Taking advantage of this fact, M. Salet places a nicol prism before the eye-piece of the telescope; this acts as an analyser on the polarised sky-light, suppressing it from passing to the eye of the observer. The light from the star is allowed to pass with undiminished intensity, and therefore is relatively augmented in brightness from what it would be as seen without the nicol prism. The arrangement has been tested on the meridian instrument at Paris, and it is stated that faint stars down to about the fifth magnitude have been satisfactorily observed at transit in full daylight.—(*Bulletin de la Société Astronomique de France*, December, 1908, p. 552, Paris Observatory, Annual Report, 1908.)

DETERMINATION OF POSITION WITHOUT AN HORIZON.—The question of finding terrestrial positions is usually associated with a measurement of altitude, which has either to be taken from the sea-level datum, if the sea horizon is visible, or from an artificial horizon, when the natural horizon is invisible. In many cases, however, neither of these methods are available, and it is desirable to devise some such procedure as would enable the occupants of a balloon, say, to determine their position with sufficient accuracy to warrant their descent on any pre-defined district whose topographical features may not be recognisable. If the error of observation is about half a degree the resulting position would be out by some 30 miles. Mr. C. V. Boys has devised an instrument to do this, of the type of swinging collimator and sextant combined. The collimator is vertical and is suspended on a gimbal frame, the whole being top-weighted like a metronome, so as to have a period of swing of about one second. The collimator is provided with a fine scale adjusted at its focal plane; above the lens is fixed a clear or half-silvered glass mirror set at 45° with the axis of the collimator. The whole is then suspended in a tube, forming the handle of the instrument, to which is attached the ordinary parts of a small sextant. When looking in the telescope the star will be seen projected upon the scale, one half of which is marked +, the other −, and by having the instrument calibrated, these readings may be made to indicate altitudes direct. Without the top controlling weight it is found impossible to hold the instrument steady enough, but when the period is increased to about one second by top-weighting, the angular movement is so reduced that by sitting at a table an accuracy of one minute of arc is possible.

BOTANY.

By G. MASSEE.

MOORLOG.—Moorlog is the name given to a peaty deposit obtained from the Dogger Bank in the North Sea, that has been investigated by H. Whitehead and H. H. Goodchild. The account is contained in the *Essex Naturalist*. This substance is a source of trouble to the fishermen, as it frequently chokes up the trawl. It usually occurs in small pieces, but occasionally some attain a length of 5 or 6 feet, but are never more than 18 inches thick. Moorlog varies in colour from light brown to almost black, and in texture from a coarse mossy deposit to a fine texture as close as wood. It readily splits into layers both when wet and dry. It consists chiefly of plant remains, stems and roots of trees, seeds, leaves, and mosses, and is essentially a fen

deposit with no trace of inorganic mud. In addition, the elytra of beetles are very common in some specimens.

The plant remains have been examined by Clement Reid, F.R.S., who considers that the deposit comes from the middle of some vast fen far from land. The vegetation consists exclusively of swamp species, with no admixture of edible fruits, usually so widely distributed by birds, and no wind-borne composites. The climate to which the plants point is sub-arctic. The white birch is the only tree present. Bog bean (*Menyanthes trifoliata*), birch (*Betula alba*), dwarf arctic birch (*Betula nana*), *Ranunculus lingua, Lychnis flos-cuculi, Valeriana officinalis, Sparganium ramosum,* and *Lycopus europæus* were abundant; *Alisma plantago, Spiræa ulmaria,* and a species of fern. The nuts of several kinds of *Carex* were also found. Among the mosses, *Hypnum intermedium* was present in fair quantity, also *H. richardsoni,* not at present a British plant.

The authors are of the opinion that the deposit exists *in situ,* and has not been drifted, becomes water-logged, and sunk, and that the facts support the views advanced by Jukes-Browne, that the Dogger Bank is the remains of a submerged plateau. Further, the existing fens of East Anglia with their fauna and flora may be regarded as a relic of a much greater fen-land, which once joined England to the Continent.

NEW METHOD OF FORCING PLANTS.—The method of forcing plants by treatment with ether, as first suggested by Johannsen, is now extensively used on a commercial scale for the purpose of securing out-of-season flowers and fruit. This process, however, will in all probability soon be replaced by the equally effective and less expensive method just described by Professor Molisch in a pamphlet called "Das Warmbad." The only treatment required is that of immersing the shoots, by inversion, in water at 30-35° C., for nine to twelve hours, and afterwards keeping the plants in a dark moist chamber at a temperature of about 25° until the leaves commence to appear, after which the plants are grown under ordinary greenhouse conditions. Lilacs, azaleas, spiræas, etc., treated as above during the middle of November were in bloom at Christmas or early in January, whereas untreated plants of the same kind had not commenced to move. Fuller methods of treatment, and the duration and temperature of the bath for different kinds of plants, are contained in the pamphlet.

DISPERSAL OF SEEDS OF GORSE AND BROOM BY ANTS.—Professor F. E. Weiss has given an account in the *New Phytologist* of the dispersal of the seeds of the broom and the gorse by ants. The idea was suggested to the author by the perusal of a book entitled "Entwurfeiner Monographie der Europäischen Myrmecochoren," by R. Sernander, in which it is pointed out that ants make use of paths and roadways for facilitating the transport of building material and food to their nests. The seeds used for food, amongst others, include *Chelidonium* and *Viola,* which contain oily food material in special structures termed elaiosomes.

Gorse, as is well known, often monopolises extensive areas, its distribution being effected by the explosive contraction of the dry pods. In addition to this mode of seed dispersion, Weiss observed the curious distribution of gorse along roadsides and over disused cart-tracks on moorlands, which suggested the probability of ants acting as agents in the dispersal of the seeds of this plant. The seeds of the gorse are provided with a brightly coloured caruncle filled with oily food-material. A series of experiments proved that when gorse seeds were placed on the ground on a track followed by the ants, they were quickly removed, the ants greedily eating the coloured, oily portion of the seed. Some seeds are carried to the nest, others are dropped by the way. Broom seeds were also carried by the ants, but fruits of burdock and wood sage were ignored.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

SECRET REMEDIES.—It was a happy notion on the part of the British Medical Association to have analyses made of all the well-known secret medicines, and to publish the results in the form of a small book. This will not only prove of the greatest use to the general practitioner, who is frequently called upon to answer questions on the subject of quack remedies, but will also be found entertaining by the general reader. Here are to be seen the composition of most of the much-advertised nostrums contrasted with extracts from the advertisements of what they claim to do, together with comparisons of their selling price with their cost of preparation. In many instances the ingredients include useful drugs, though only faith can have effected the marvellous cures attributed to these. In other preparations the ingredients are harmless though useless; and in others, again, decidedly dangerous. Take, for instance, the remedies advertised for the reduction of fat. The majority of these contain an extract of the seaweed bladder wrack (*Fucus vesiculosus*), which, notwithstanding the fact that it is used in Ireland for fattening pigs, has in some way or other acquired a reputation for making human beings thin. Other "anti-fat" medicines contain citric acid, evidently inspired by the notion that drinking sour liquids produces thinness, and some contain dried thyroid gland, which can scarcely be regarded as "quite harmless" when taken by "the fat woman who is an enemy to the artistic uplift, for she is entirely too heavy for any wings of fancy to raise." One ingenuous advertiser, professing to cure cases of consumption "that defy ordinary treatment," meets the objection of secrecy by the statement: "The great drawback to my cure, so far as the medical profession is concerned, has always been the fact that I would not reveal its formula. This is now done away with; its formula is 80 grains of umckaloabo root and 13½ grains of chijitse to every ounce, prepared according to *British Pharmacopœia* methods." It is not surprising that enquiries in various parts of South Africa failed to elicit any information of the existence of these reputed plants. "Umckaloabo" and "chijitse" were quite unknown to the natives. Although in some instances secret remedies, though expensive, may prove effective, in other cases they are shown to be a cruel fraud upon the sufferers, whom they often prevent from obtaining skilled advice before it is too late. One of the most widely advertised cures for cancer, for instance, has been found to consist of nothing but water.

VITALITY OF THE CHOLERA VIBRIO IN WATER.—The recent outbreak of cholera in Rotterdam gives a special interest to the *Report on Research Work,* of the Metropolitan Water Board, dealing with the vitality of the cholera micro-organism in artificially infected samples of raw river water. In the experiments carried out by Mr. A. C. Houston definite quantities of water from the Thames, Lea, and New River were inoculated with the same quantities of an emulsion containing known numbers of the cholera organism, and these were kept at the ordinary temperature in the dark. Tests of the number of vibrios present were made each week, and it was found that in none of the 18 experiments did any of these organisms survive more than three weeks, and that nearly the whole of them (99.9 per cent.) died within a week. The general conclusions drawn from these experiments is that storage rapidly destroys the cholera vibrio in raw river water, as has previously been found to be the case with the bacillus of typhoid fever, and that storage prior to filtration would prove an efficient safeguard against epidemics of disease being brought about through the medium of drinking water.

ANALYSIS OF OILS.—A new method of distinguishing between different oils has been devised by M. E. Louise. It is based upon the fact that if acetone be mixed with a fatty oil at a definite temperature, the composition of the two layers into which the mixture separates on standing remains practically constant, whatever the amount of the respective liquids used. With the rise in temperature the two layers approximate to each other in composition, until, at a certain point, they blend, forming a fluid of homogeneous character. This point, termed the *temperature of miscibility,* is characteristic for each kind of oil, when observed under constant conditions. The curves of miscibility are almost parallel in the case of different samples of the same kind of oil, but differ considerably in the case of other oils. Thus the curves given by cotton-seed oil and sesame oil fall below, and are far removed from the curves

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given by olive oil, while the curve of earth-nut oil falls above that of olive oil, without, however, being far from it. By plotting the curves it is possible to make an approximate estimation of the amount of sesame or cotton-seed oil in an adulterated sample of olive oil, but in the case of earth-nut oil, the results will be less exact. The principle of the method may also be used in the estimation of water in oils, and in the analysis of glycerine, petroleum spirit, etc.

GEOLOGY.

By EDWARD A. MARTIN, F.G.S.

HIMALAYAN GEOLOGY.—The geology of the Himalaya is dealt with in Part IV. of the "Geography and Geology of the Himalayan Mountains and Tibet," by Colonel S. G. Burrard, and Mr. H. H. Hayden, of the Geological Survey of India. The rocks of the Himalaya fall into three broad stratigraphical zones: (1) a southern sub-Himalayan zone, for the most consisting of tertiaries, and including the well-known Siwalik and Sirmur series; (2) a central or Himalayan zone, comprising most of the ranges of the Lesser Himalayas, together with the line of high peaks, these being composed of granite and other crystalline rocks, together with fossiliferous sediments of unknown but probably pre-Cambrian age; (3) a northern or Tibetan zone, lying north of the axis of the great Himalayan range, and comprising highly fossiliferous rocks ranging from Cambrian to tertiary.

THE SIWALIK SERIES.—The Siwalik series are of enormous thickness, averaging over 16,000 feet, during the deposition of which the wide area over which they were being laid down was constantly sinking, and they appear to have been deposited sub-aerially by streams and rivers along the outer margin of the Himalayas. During the vast period of time necessary for their deposition, the main drainage lines of the mountains must have been much as at the present day, and hence the antiquity—since pliocene times, at least—of the more important rivers of the Himalayan region. Forming the northern boundary of the Siwalik series lies the great reversed fault known as the "main boundary fault," which probably extends the whole length of the range, from Assam at least as far as the Beas. The older rocks have been thrust up over the younger, by tangential strains acting in opposite directions, and finally fracturing when the earlier foldings could no longer stand against persistent strain. The other tertiary beds, the Sirmur series, are identified as of Eocene age, in consequence of the occurrence of *Nummulites* in the Subathu stage. Certain beds of tertiary coal are also found in the series.

THE ZONE OF MOUNTAIN PEAKS.—The Himalayan zone contains rock-groups which have been the source of much difficulty. The great lines of mountain-peaks fall into this zone, and the rocks form two chief sub-divisions, the granites, gneiss, and crystalline schists of tertiary age, and a series of fragmental rocks of undoubtedly sedimentary origin, which contain no fossils, and are now regarded as of pre-Cambrian age, being an isolated northern extension of those ancient systems of sediments which are found in the southern parts of the peninsula, which have been caught in the great earth-folds which produced the Himalayan range.

THE TIBETAN ZONE.—The Tibetan zone is in marked contrast to the other two zones of the area. It extends far into Tibet, and comprises one of the most complete representations of the geological record to be found in the world. No period remains unrepresented. The zone is found north of the main crystalline axis of the range. Its thickness is more than 20,000 feet, and these consist of sediments almost entirely of marine origin. The Himalayan tertiary granite has pierced it in ramifying branches, and metamorphosed many of its component members. The existence of so complete a series has revealed the striking fact that during the whole of the enormous time covered by historical geology, the northern slopes of the range lay beneath the waters of a sea, stretching at one time to China and at another to the Mediterranean, a gradual subsiding movement taking place all the time. They have since been raised, and form part of the highest mountain range in the world.

METEOROLOGY.

By WILLIAM MARRIOTT, F.R.MET.SOC.

THE METEOROLOGICAL OFFICE.—The Meteorological Office was established in 1854 as a department of the Board of Trade. From 1866 to 1877 it was carried on with a Parliamentary Grant in Aid, under the management of a committee, and from 1877 to 1905 under a council appointed by the Royal Society; and it is now under the control of a director and committee appointed by H.M. Treasury. Dr. W. N. Shaw, F.R.S., is the director and chairman. The fourth annual report for the year ended March 31, 1909, has recently been issued. This gives particulars of the work done by the branches into which the Office is divided, viz., (1) Marine; (2) Forecast and Storm Warning; (3) Statistics and Library; (4) Instruments; (5) Investigation of the Upper Air; and (6) Correspondence and Accounts.

The arrangements for the issue of the Daily Weather Report and Forecasts and for the preparation of information for publication in the newspapers have remained generally the same as in previous years, but owing to the establishment in July, 1908, of a 7 a.m. service in the British Isles, the preparation of the Report has been accelerated. The most important new feature was the offer, on the part of the Office, to supply special information of the commencement of a probable spell of fine weather lasting for at least two or three days. A comparison of the forecasts for the United Kingdom issued at 8.30 p.m. with the weather actually experienced shows that the percentage of "complete success" in the forecasts was 58, and of "partial success" 34. The term "partial success" is applied to cases in which more than half the details included in the forecast are justified by subsequent events. With regard to wind the details comprise direction and force, and anticipated changes in either particular. With regard to weather they comprise temperature, the state of the sky (clear, cloudy, or overcast), and the probability of rain, snow, fog, thunder, etc., with occasional indications as to the duration or intensity of any or all of the phenomena mentioned.

THE WETTEST PLACE IN WALES.—It has always been considered that the Stye at the end of Borrowdale, Cumberland, is "the wettest place in England," as considerably more rain is measured there than at any other place in England. The average annual rainfall is about 170 inches. In *British Rainfall* for 1908, Mr. A. Lockwood, in an interesting article on "Rainfall in Snowdonia," gives the records from 13 rain gauges in the district for 1908. As three of the gauges were examined each day at 9 a.m. there can be no doubt as to the accuracy of the observations. The total rainfall for 1908 recorded by the gauge placed on a grassy slope (1,480 feet above sea-level) near the Copper Crushing Mill on the Snowdon side of Llydaw was 237 inches, while on a grassy shelf (2,340 feet above sea-level) near a small pool between Pen-y-Gwryd track and the top of Crib Goch the total rainfall was 192 inches. It seems as if this district may be considered as the wettest place in Wales, and possibly in the British Isles.

DISTRIBUTION OF WEATHER FORECASTS IN THE UNITED STATES.—Professor W. L. Moore, the Chief of the United States Weather Bureau, in his Annual Report for 1908, in speaking of the weather forecasts, said that diligent efforts have been made to increase the distribution along all lines; but, as in the previous year, the principal part of this work has been directed toward the dissemination of forecasts through the medium of the telephone companies, and they have responded almost unanimously to the invitation to co-operate for the benefit of their subscribers. During the year several States of the Middle West and on the Pacific slope were canvassed, and as a result a large

number of telephone companies in those States are now co-operating with the Bureau in this important work.

One of the largest telephone companies operating in the Southern States, which has heretofore declined to take up the work of distribution, has fallen into line and is now giving its subscribers the benefit of the daily forecasts through a large number of exchanges, particularly in the States of Mississippi and Tennessee.

In the States of the Middle West the telephone is largely used for transmitting forecasts, and the weather information is much appreciated. The officers of the companies state that the number of calls that come into "central" daily for weather reports is surprising. They say that it is an advantage to them to have the opportunity of distributing the information free, as such action aids in securing more subscribers. Some officials, in fact, are enthusiastic in their commendation. A special correspondent of the *New York Evening Post* writes from Kansas City, Mo., as follows:—

> "Little wonder that every day's weather predictions are awaited with interest. Early in the morning in the central telephone stations of the grain countries the calls come in to know 'What does the weather man say?' The farmers' lines are kept busy answering these calls until nearly noon. So insistent is the demand for this news that many of the companies send out a general call for all subscribers at 9 o'clock, and read the bulletins."

The greater portion of the telephone companies are now publishing in some prominent place in their directories the following notice:—

> "Subscribers of this Company may obtain the daily forecasts and special warnings of the Weather Bureau of the United States Department of Agriculture from their respective exchanges after 11 a.m., eastern time. These forecasts usually cover the thirty-six hour period ending at 8 p.m. of the following day."

ORNITHOLOGY.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

COLOUR CHANGE IN THE BLACK-HEADED GULL.—That the Black-headed Gull develops its characteristic "black" hood by a migration of pigment into hitherto colourless feathers, and that similar colour-changes obtain in many other birds, has been warmly maintained by a large number of ornithologists in this country, and by a few in America. Yet we have always held that for such a method of change there was not the slightest evidence.

Mr. Philip Bahr has set the question at rest in so far as *Larus ridibundus* is concerned, at any rate, and in the opinion of most of us, perhaps, of all similar cases, in the September issue of *British Birds*. His thorough and careful handling of the theme leaves nothing to be desired, and must be regarded as conclusive and final. He has shown, in short, that this accession of colour is gained by moulting, the change taking about a week to complete. We cannot analyse his results in this column, but commend the perusal of his paper, which is admirably illustrated, to all who are interested in this problem.

RED-RUMPED SWALLOW IN KENT.—Mr. M. J. Nicoll, in *British Birds* (September), gives a photograph and a short account of a Red-rumped Swallow (*Hirundo rufula*), which he saw on May 16, 1909, at Jury Gap, on the boundary of Kent and Sussex. This makes the second recorded occurrence of this species in Great Britain.

ROSE-COLOURED STARLING IN LINCOLNSHIRE.—In *British Birds* (September), Mr. W. E. Suggitt records the fact that he had the good fortune to watch a male Rose-coloured Starling feeding on some late cherries in his garden on August 1. The bird remained in the vicinity of the trees all day, but disappeared early in the following morning. We are glad he did not shoot it.

OSPREY IN CO. SLIGO.—The Rev. F. C. R. Jourdain reports the fact that an Osprey was seen on May 29 on Lough Arrow, Co., Sligo, a late date, as he remarks, for this bird on migration northward.

NESTLINGS OF THE STORM PETREL.—Major H. Trevelyan, in the *Field* (September 18), contributes a most interesting note on Nestlings of the Storm Petrel examined by him on an island off the coast of Co. Donegal in August last. Herein he draws attention to the fact that the young are hatched practically blind, and with a bald spot on the top of the head. The bare skin does not seem to have been conspicuously coloured, however, as is the case in nestlings of the great crested grebe, which have a heart-shaped patch of bare skin, on the crown, of a brilliant vermilion red. What purpose such bare areas may serve, or what may be the significance of colour, or its absence, in this region is a problem as yet unsolved.

A MONKEY-EATING EAGLE.—All who are within easy reach of the Gardens of the Zoological Society of London should make an endeavour to see the magnificent specimen of the Monkey-eating Eagle (*Pithecophaga jefferyi*) which has just been added—the first of its kind ever seen alive in Europe. This huge bird, a native of the Philippines, is a forest eagle, and, as its name implies, feeds largely on monkeys. Resembling the great Harpy eagles, it differs therefrom, and from all other eagles, in the great size of the beak, which is curiously flattened from side to side. It is further peculiar on account of the great length of the feathers of the crown, which gives the bird a very striking appearance.

This bird, in spite of its great size, has not long been known to science. The first specimens were obtained by the late John Whitehead, and were described by Mr. W. R. Ogilvie Grant, of the British Museum, in which institution the type specimens are to be seen.

PHYSICS.

By PROFESSOR A. W. PORTER, B.Sc.

THE PRESSURE OF RADIATION AGAINST THE SOURCE.—The theory (first enunciated by Clerk Maxwell) that light should exert a pressure upon any body on which it fell has been verified by Lebedew, Nichols, and Hull. From the principle of equality of action and reaction it is evident that a back pressure must be exerted upon any body which is giving out light or radiation of any kind. Professor Poynting, in a preliminary communication to the British Association at Winnipeg, described some first measurements, made by himself and Mr. Guy Barlow, of the pressure exerted. It would not be convenient to use an incandescent body for this purpose, owing to the disturbances that would arise. Instead, a thin slip of black or bright material is exposed to radiation, its temperature rises until the loss by radiation is equal to that which it receives. A perfectly black material will suffer the pressure due to the incident radiation, and that alone, since it radiates equally on both sides—at least if it is thin enough to be sensibly affected at the same temperature on both sides. This pressure is equal to the density of the energy of the radiation E. A perfectly reflecting surface (such as silver approximates to) will experience a pressure equal to 2 E, since the beam of radiation is reversed by it, and, again, there will be no other pressure in this case, because no rise of temperature will take place. But if a metal film, blackened on one side, be taken with the black side toward the incident beam there will be an extra pressure due to the inequality of the emission from the two sides. The measurements that have been made so far agree remarkably well with the expected values.

Incidentally, these results give rise to the question as to how far the measurements made on the pressure of incident radiation are affected by a source of error arising from this cause. In the discussion which followed it appeared that Professor Hull was alive to the possibility of an error and his experiments had been carefully designed so as to exclude it.

POSITIVE ELECTRICITY.—Opening a discussion on positive electricity, Sir J. J. Thomson outlined the arguments which can be adduced in favour of the view that there is a

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natural unit of positive electricity analogous to the unit of negative, which is known as an electron. The discussion which ensued brought out clearly that at present experimental knowledge is far too indefinite to warrant acceptance of any of the various views. Experiment is in favour of the recognition of fundamental differences in behaviour between positive and negative electricity which are not adequately represented by a mere difference in sign, although some mathematical physicists are still conservative enough to retain the pre-Faradaic view; but beyond this it is not safe to go.

ZOOLOGY.

By R. LYDEKKER.

A REMARKABLE GOAT.—The zoological event of the month is the description, in the *Geological Magazine*, by Miss Dorothea Bate, of the imperfect skeleton of a most remarkable type of dwarf goat, recently discovered by herself in a cave in the island of Majorca. Miss Bate has been remarkably successful in the discovery of remains of dwarf hippopotamuses and elephants in the caverns of Cyprus and elsewhere, but the new goat may be described as her crowning effort. For this goat, which has been appropriately named *Myotragus balearicus*, differs not only from all members of its kind, but from all other known ruminants in the reduction of its lower front teeth to a single pair of permanently growing, chisel-like incisors, which accord with those of rodents in almost every particular, not even excepting the restriction of the enamel to the lower and outer surface. By what these teeth were opposed in the upper jaw is, unfortunately, not known, as, with that provoking luck so common in the case of fossil bones, the extremity of the muzzle of the skull is lacking. The peculiarity of the Balearic goat is, however, not restricted to the teeth, for the cannon-bones of the feet are remarkable for their extreme shortness and breadth, features in which they excel the corresponding bones of the takin and the Rocky Mountain goat.

At what period this extraordinary goat lived, why it died out, and the reason for its dental and skeletal eccentricities, are questions which cannot at present be answered. Judging from the appearance of the bones themselves, it might be surmised that this ruminant flourished up to quite a recent date; but as the condition of cavern-remains is extremely untrustworthy as a clue to their age, it would be hazardous to draw any conclusions with regard to this point. It may be hoped that strenuous efforts will be made to procure additional remains of this most curious new type of ruminant. Our congratulations, it need scarcely be mentioned, go to Miss Bate on her latest and most unexpected discovery.

A NEW SEA-ANEMONE.—That the zoological harvest of the sea seems to be by no means fully reaped appears to be indicated by two recent discoveries of considerable interest made in Indian waters. The first of these is a new type of pelagic sea-anemone, specially characterised by the absence of the oral tentacles, which form such a distinctive feature of the other members of the group, and which has led Dr. Annandale to propose for the new organism the designation of *Anactinea pelagica*. These remarkable anemones were discovered by one of Dr. Annandale's native assistants in the tide-wash of the Orissa coast of Bengal, and when first found were spherical in shape, although when placed in water they changed to an ovate form.

A NEW ANNELID.—The foregoing discovery has, however, been eclipsed on the opposite side of the Bay of Bengal, where, off the coast of Arakan (as well as on the Gulf of Manaar), the naturalists of the scientific surveying ship *Investigator* have brought to light an entirely new type of gephyrean worm, for which the name *Investigator sicarius* has been proposed. This annelid presents such remarkable structural peculiarities—for the details of which our readers may be referred to the original description by Captain F. H. Stewart, in the *Memoirs* of the Indian Museum—that it is regarded as constituting by itself a new ordinal group.

REVIEWS OF BOOKS.

ASTRONOMY.

The 45th issue of M. Camille Flammarion's **"Annuaire Astronomique et Meteorologique,"** that for 1909 (pp. 295 with 82 illustrations; price, fr. 1.50), contains, as usual, several interesting notes, tables, and short articles in addition to the ordinary tabular matter expected in an almanac. These include such interesting tables as that of the highest and lowest readings of the thermometer at Paris from 1699 to 1907, from which we learn that 40°C. or 104° Fahrenheit, has been twice recorded, the more recent occasion being August 26, 1765, and the lowest reading in the series -23°.9 C. or - 11° Fahrenheit, occurring December 10, 1879. The subjects of the Ruddy Moon (La Luna Rousse), and the Ice-Saints, are investigated without prejudice by M. Flammarion, who finds no justification for the popular belief in the cold-bringing capacity of a particular moon on three particular days in May. This result is the more striking inasmuch as in continental countries the three ice-men are much more firmly established in proverbial lore than in England. We may add that the Greenwich records are equally discouraging to the popular superstition. Full details are given of advances in astronomy during the year in every branch of the science, and also of unusual meteorological phenomena, which include a realistic description of the effect of a lightning stroke on a Brazilian military officer, given by the actual victim himself. The volume is quite full of interesting features which cannot be enumerated here, and will well repay perusal.

BOTANY.

Trees and Their Life Histories, by P. Groom and others (Cassel and Co., issued in 13 shilling parts).—The appearance of this excellent book on Trees by a well-known authority on the subject, in parts, will enable many students and others to become possessed of the most reliable and up-to-date work on trees extant. The illustrations are numerous and excellent, and the general treatment of the subject is admirable, not only enabling anyone to learn the name of a given tree, but also to know why it exists under its present form and to follow the struggle with its competitors in attaining such form and characteristics.

Familiar Wild Flowers, by F. E. Hulme, F.L.S., F.S.A. (Cassel and Co., issued in 45 sixpenny parts).—We welcome a new edition of this well-known work, which has in the past been the means of inspiring a love for our wild plants in numerous instances. The many coloured plates are excellent, and the text is written in a manner that conveys a considerable amount of information without being swamped with scientific terms.

CHEMISTRY.

Exercises in Physical Chemistry, by Dr. W. A. Roth. Translated from the German by A. T. Cameron, M.A., B.Sc. (London: Constable and Co.; pp. xii. and 196; 6s. net).—The object with which this book was written was to provide a beginner with an introduction to the use of physico-chemical methods, and having been devised by a practised teacher it well fulfils its purpose. After an introductory chapter on the methods of calculation used in physical work, chapters are devoted to the determination of density, of molecular weights, and of thermal and optical constants. The five chapters forming the second half of the book deal with electro-chemistry, and the work concludes with a number of useful tables and a good index. The translation is admirably done, and the book is well printed and illustrated with drawings of apparatus. By way of criticism, it may be urged that, since the book is intended as an introduction to larger treatises, it would have been advisable to have included such exercises as the calibration of a burette, which are necessary even to the chemist who does not intend to study the physics of chemistry; but this, of course, is a matter of opinion.

The Precious Metals; Comprising Gold, Silver and Platinum, by T. Kirke Rose, A.R.S.M., D.Sc. (London: Constable; pp. xvi. and 295; 6s. net).—Specialisation in chemistry has now reached such a pitch that each important element has its own chemical literature, scattered for

the most part throughout scientific journals all over the world. In the present book the author has not attempted to summarise everything that has been written about gold, silver, and platinum, but to give a general introduction to the study of these metals and to provide a work of reference on the subject. In each case an outline is given of the history, properties, compounds, and alloys of the metal, together with a description of the methods of extracting it from its ores, its assay, and its manufacture into useful products. The book is clearly printed, and fully illustrated with diagrams and photographs of the plant used in the extraction processes. It certainly fulfils its aim as regards the reader with little knowledge of chemistry, but for the chemist its value as a book of reference would be greatly increased by the inclusion of a classified bibliography of scientific papers on these precious metals.

GEOLOGY.

The Stone Ages in North Britain and Ireland, by Rev. Frederick Smith (London: Blackie and Son, Ltd.; 16s.).—Under the comprehensive title of "The Stone Ages in North Britain and Ireland," the author has brought into notice the finds he has made of stone implements over nearly forty years, with the object of showing that Palæolithic man in Scotland was pre-glacial, or at all events inter-glacial, and of calling attention to many forms of implements which have not hitherto received from students of the Stone Ages the attention which they have deserved. Owing to the comparatively perishable nature of the rocks from which, in the absence of flint, the stone implements in the North of Britain were necessarily made, there must always be considerable difficulty in identification of implements which have been much water-worn or are far travelled. Illustrations by any process must therefore be far less convincing than the inspection of the specimens figured, and this is unfortunately still more the case when the illustrations are photographs of drawings, as in the book at present under review. A very slight touch of the draughtsman will often in an illustration convey the idea of human workmanship on a specimen which when handled and examined will be far from convincing to an expert. Unfortunately, also, the author has not drawn all his illustrations to the same scale, and no guide is given to the size of the specimens illustrated except the general expression in the first chapter that the objects illustrated are "half natural size," to which scale from the measurements given in the text it is very evident the illustrations, in some instances, only approximate. The domestic implements which Mr. Smith describes are limited in number, probably owing to the materials from which they are made, for eliminating the flint specimens, chiefly found on the Ayrshire coast, doubtless the saws, scrapers, and drills which are so commonly found in flint would be almost unrecognisable if made from granite, schist, etc., especially if much weathered or rolled. The principal objects described are, therefore, flayers, mullers, knives, and choppers, which are also illustrated in very considerable detail. We entirely agree with the author that as long as the collection of specimens is largely confined to workmen who have been taught to look for "orthodox forms," principally "hâches" our knowledge of domestic implements of both Palæolithic and Neolithic man must remain very limited. Information respecting men of the Stone Ages can only be attained by industrious collecting by those who are real students of prehistoric archæology. With regard to the forms which are usually recognised as Neolithic, which the author has also found in boulder clay, from which he argues there was no break in continuity between Neolithic and Palæolithic man, we are not prepared to accept his conclusions upon this ground alone. The same argument—the similarity of form—could equally well be used to argue that all stone-using races were one. It is more probable that the same needs have caused various races to arrive at the discovery that similar forms best suit their requirements and that this is the principal reason why like forms of implements are used by races as far apart in distance as the Tasmanian and North American, or in time as the Tasmanian and Palæolithic man of Belgium, France, and Great Britain. We welcome the author's advocacy of the study of these domestic implements, for we are convinced that it is by this method we shall best arrive at a true knowledge of Palæolithic man. We think, however, he does scarce justice to the eoliths of our southern counties and Belgium when he says that "these forms bear little evidence of intention; indeed, they are often naturally-produced flints." We are not aware that Mr. Benjamin Harrison, to whom he alludes, or any other upholders of the theory of eoliths being the oldest known work of man, have ever rested their case upon "naturally-produced flints," but happily in the next sentence Mr. Smith gives away his position that eoliths are not of human workmanship but "naturally-produced flints," by stating: "They, however, exhibit certain characteristics even as to form which are distinctly obvious when numbers are placed side by side." "This 'cumulative' evidence is also very strong in the feature of the marginal chipping. In fine, the chipping, when numbers are studied, has an undoubtedly artificial aspect." We feel that "The Stone Ages" is after all a valuable contribution to the study of stone implements as it breaks fresh ground by the consideration of many forms which can be traced through the three periods, Eolithic, Palæolithic, and Neolithic, and should considerably assist investigation into the habits and civilisation of our earliest known ancestors.

MISCELLANEOUS.

British Rainfall, 1908, by Hugh Robert Mill (London: Edward Stanford, 13, Long Acre, W.C.; 8vo., 404 pp.; 10s.).—This valuable publication, which is now in its 48th year, deals with the distribution of rain in space and time over the British Isles during the year 1908, as recorded by more than 4,500 observers. This is an increase of 193 records over the previous year. There is an important new departure in the treatment of monthly rainfall. Two maps are given side by side; one showing the actual amount of the fall in inches, the isohyetal lines being reduced from a large-scale map on which are plotted the returns from about 200 stations; the other, based on a much smaller number of points, shows the variation from the average of the month, indicating by shading the various degrees of wetness or dryness, as judged by the standard of the normal for the month in question. With regard to the character of the year 1908, it is seen to have been on the whole moderately dry, but the coloured frontispiece shows that the average was exceeded in some parts of the country though not reached over a large area. April and September were the months of largest rainfall in general, June and October those of the smallest. The Rainfall Organisation does a national work, and is recognised in many ways as of public utility; but it has no financial support save the subscriptions of a limited number of the observers and the personal credit of the Director, Dr. H. R. Mill, who bears the whole responsibility of keeping the system going from year to year. He feels the importance and the impending necessity of some more stable guarantee of permanence, and seizes the opportunity of a generous gift from an observer to make of it the basis of an Endowment Fund, which may, some time in the future, supply an income which will materially augment the subscriptions, and enable the data which come in to be more thoroughly and more quickly discussed.

Survey of India; The Pendulum Operations in India; 1903-1907, by Major G. P. Lenox Conyngham, R.E. (Dehra Dun: Offices of the Trigonometrical Branch, Survey of India).—This paper contains a detailed account of all the observations made with the Indian half-seconds pendulum apparatus from 1903 to 1907. The ultimate object is to make a complete gravimetric survey of the whole country. In the first instance, two primary problems have been attacked. First, to ascertain the extent to which visible excesses of mass, such as mountains, are compensated by deficient density; secondly, to find out whether there exists (as inferred by Colonel Burrard from astronomical latitudes and longitudes) a chain of excessive density running more or less parallel to the Himalayas, distant some 150 miles from them and extending from the Bay of Bengal to the Punjab. The answer given here to the former question is that in no case is the compensation complete. Evidence is afforded of the existence of Colonel Burrard's chain.

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MICROSCOPY

Conducted by F. SHILLINGTON SCALES, M.A., F.R.M.S.

I AM glad to be able to announce that by arrangement with the proprietors of "KNOWLEDGE" the space hitherto devoted to Microscopy will be considerably enlarged, and will in future consist of not less than four pages, instead of two pages as hitherto. The great interest taken in the subject by the readers of "KNOWLEDGE" justifies this increase of space, and the recent enlargement of the magazine renders it possible. I shall be glad if any readers who are able to contribute suitable papers will communicate direct with me.

Dark-Ground Illumination.

THE use of the spot lens is no new thing and the beautiful effects given by its means with suitable objects are known to most microscopists. The principle is simple enough. An ordinary condenser is used, which can pass a large cone of light, and the central portion of such a cone is blocked out by means of a stop placed in a ring beneath the condenser, so that only the periphery of the condenser is used, and the central portion is deprived of all light. It follows that when the condenser is focussed upon the slide any object mounted upon that slide will be illuminated by the peripheral rays only, or, put in more conventional language, all rays below a certain angular aperture will be cut off, and only rays beyond that aperture will be allowed to pass. If, now, an objective be used whose angular aperture is no larger than the central cone of illumination thus blocked out, and there be nothing upon the slide, the whole field will appear dark, and if the correspondence be exact it will appear quite black. The accompanying diagrammatic illustration will make this clear (Fig. 1). But if there be an object on the slide which has good refractile powers—let us say, some foraminifera—the foraminifera will catch the peripheral rays which were too wide to enter the objective, will refract them in all directions, will by this means become self-luminous objects, and will accordingly become visible as bright and beautiful objects shining upon a dark back-ground.

It will readily be seen that to obtain good dark-ground effects the condenser must not only be able to pass a cone of light larger than that embraced by the objective, but that the spot must cut out a cone of light exactly proportioned to the angular aperture of such objective. The magnification of the objective does not enter into the matter, except in so far as there is generally a proportionate increase of aperture with increase of magnification, and therefore a $\frac{3}{5}$-inch achromatic objective of .3 N.A., and a 1-inch apochromatic of the same aperture would require a stop of identical size.

In the proportioning of these stops to the objective used lies one of the difficulties of getting good dark-ground illumination. Fig. 2 shows two of such stops, and the larger stop—that which cuts out the larger cone of light—will, of course, be used with an objective of higher aperture, for it should be unnecessary to remind the reader that the angle of aperture, or the size of the cone of light embraced by an objective (measured as an angle), is a different thing to the mere *diameter* of the front lens of an objective, the lowest powered lenses (all other things being equal) having the largest diameter, but the least angular aperture, focussing as they do so much farther away from the object. So that the large stops (we are dealing with discs, and not with size of opening, as in photography) are used with the higher powered lenses, and the small ones with the lower.

It would be of little service were means given here by which the exact size of stop could be found for each objective when used with a certain condenser. Two or three stops, of sizes varying from $\frac{3}{8}$ to $\frac{3}{4}$ of an inch and costing 1s. each, are generally sufficient to give fairly good results with most objectives, and more precise adjustment can conveniently be made by means of a "Davis shutter," which is merely an iris diaphragm screwing above the objective, by which the

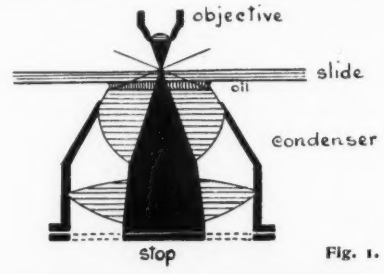

Fig. 1.

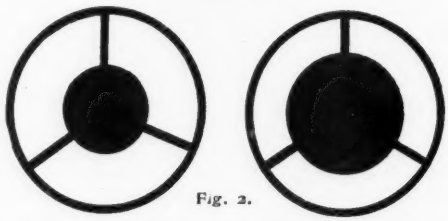
Fig. 2.

aperture of the latter can be cut down so as to give the best effects. Still more satisfactory is the ingenious "Traviss" adjustable stop (Fig. 3), which allows of exact adjustment from $\frac{4}{10}$ to $\frac{3}{4}$, or even from $\frac{4}{10}$ to $\frac{9}{10}$ of an inch. It must be borne in mind that these adjustable stops need to be treated with care, as they are easily damaged.

It will be found, however, that as we use higher powers, in spite of every care in adjustment, the dark-ground illumination by means of a spot beneath an ordinary condenser becomes less and less satisfactory, until when we approach apertures of about .6 N.A., say, $\frac{1}{4}$-inch achromatic or $\frac{1}{2}$-inch apochromatic, we find this method no longer available. The optical construction of the ordinary sub-stage condenser, in fact, no longer lends itself to this form of annular illumination.

It is here that the use of a true paraboloid or spot lens of the old-fashioned type (until lately quite fallen into disuse) comes in. Recently these paraboloids have been re-introduced as immersion spot lenses for use with quite high powers, and it is their extending use, and the fact that they not only give beautiful effects, but are of proved utility, that has prompted the writing of this article, the more so because they are not easy to use unless their principles are clearly understood. They are made by Beck and Watson in this country, and by Leitz, Reichert, and Zeiss abroad. Beck's

form was noticed in "KNOWLEDGE" for May, 1908, page 115, and has an adjustable front lens to permit of some variation in thickness of slide (a point which will be alluded to presently). Watson's form (illustrated in Fig. 4) has the advantage of being constructed for use with slides of as much as 1.3 millimetre thick, and of being interchangeable with the optical part of any of their condensers, thus saving 10s. for mount. Leitz's form has hitherto been of the construction shown in Fig. 5, a construction which, though praised by some workers, has since been altered by the makers to the more usual pattern, shown by Zeiss's construction (Fig. 6), a little examination of which will

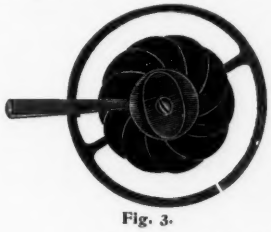

Fig. 3.

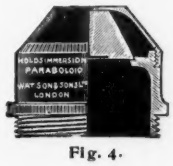

Fig. 4.

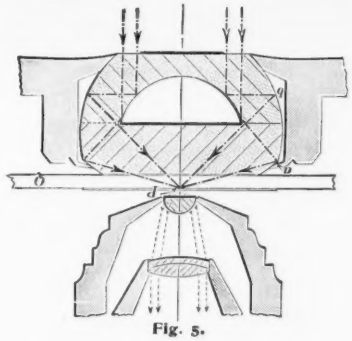

Fig. 5.

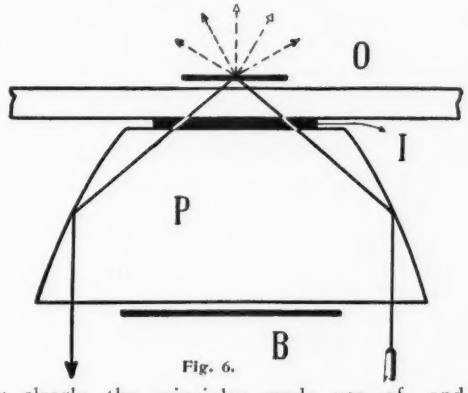

Fig. 6.

show clearly the principles made use of, and the necessity for the paraboloidal rather than the spherical shape. The necessity for immersion contact is obvious as without such a medium all rays exceeding, say, 170°, would be totally reflected and lost. All these condensers with mound and centring screws for sub-stage (where not already provided) cost about £2 each. Leitz, indeed, makes a smaller form to lie upon an ordinary stage as a stage plate, but it is so much below the other type in performance that it need not be more than alluded to here.

It will be seen that the principle of all these condensers is that of annular illumination by the blocking out of the central cone, but the paraboloidal form is suitable for use with the highest powers, and the fact that the rays of light are reflected from the surfaces instead of refracted does away with chromatic aberrations. But in each case the aperture of the objective must not exceed the aperture of the central cone of light which is blocked out. As these paraboloidal condensers are oil-immersion condensers, they are constructed to pass light exceeding, *but not less than*, 1 N.A., and it follows that the objective must not have a higher aperture than, say, .95 N.A., on the principles already enunciated. With a dry lens, say, a $\frac{1}{6}$ or a $\frac{1}{8}$ inch, this is easy enough, as no dry lens can have a larger aperture, but when an immersion lens, say, a $\frac{1}{12}$ inch of 1.3 or 1.4 N.A., is used its aperture must be reduced to this limit accordingly. This is done by screwing a diaphragm or funnel of the requisite size above the optical part of the lens, instead of the usual brass mount, and this can readily be adapted to any existing immersion lens, and, being removable, without impairing its efficiency for other purposes.

These paraboloidal dark-ground condensers are being widely used just now for the study of living unstained bacteria in medical and bacteriological work, and especially for diagnosis in recognising so elusive an organism as the *spirochaeta pallida*. A film containing bacilli like *B. coli* shows up well, the movements of the bacilli being watched with ease, until one can almost fancy that one sees the living flagella, and those who cannot easily get hold of the necessarily jealously guarded cultures of our bacteriological laboratories can derive no little interest from the investigation of a minute scraping of the teeth in the most carefully kept mouth.

It has already been said that these condensers are not easy to use unless their principles are clearly understood, and I may conclude with a few hints as to practical working, which may be of service.

A strong light is necessary. The arc lamp is not too strong, and Leitz makes a little 4-ampère arc lamp, adjustable by hand, which can be run off any domestic lighting circuit and which costs only £2. But quite good results can be obtained with a good incandescent gas lamp, not more than a foot away from the microscope, or a $\frac{1}{4}$-ampère Nernst electric lamp. In this case, however, an auxiliary condenser of the bull's-eye type must be used—preferably a well-corrected one—but a small flask filled with water and placed close to the source of illumination will give fair results. A screen of blue glass or a few crystals of sulphate of copper in the flask much improve the image. Time spent in adjusting lamp, auxiliary condenser, and mirror will save much subsequent trouble. First adjust the microscope for ordinary microscopic examination, having the microscope upright, using the *ordinary* sub-stage condenser for the moment, and adjusting lamp, mirror, and condenser in the usual way, centring and focussing the latter to give the brightest illumination. If there is no sub-stage condenser, use the mirror alone, but in either case use the plane mirror and not the concave one. Now put the auxiliary bull's-eye condenser between lamp and mirror, with the plane side quite near the lamp, and at right angles to and in the centre of a line drawn from mirror to lamp. The fingers held over the mirror will show if the beam of light is directed rightly. If the flask be used it must be supported at the right height, and also close to the light. Now insert the paraboloidal condenser, after removing the ordinary sub-stage condenser, centre it by means of the fine rings engraved on its surface, or by a minute drop of cedar-oil placed in its centre (this will have to be done with a low power, say, a $\frac{3}{4}$-inch or

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less), and lower the front lens of the paraboloidal condenser very slightly below the plane of the stage. Add more cedar-oil, place a slide on the stage and bring the condenser up into contact with the under-surface of the slide. Quite a considerable thickness of cedar-oil will be found necessary, and oil globules must be skimmed off. This bringing of the condenser up to the slide helps to avoid the formation of more oil globules. Replace the low-power lens used for centring by the immersion lens (stopped down to .96 N.A., as already explained), and focus the latter. The paraboloidal condenser may need slight vertical or horizontal adjustment to get the best effect, but it will be found that a mere touch makes all the difference, and, of course, good immersion contact must be maintained. If properly adjusted any air-bubbles will be seen to be brilliantly illuminated at their periphery, and in a condenser like Watson's, which fits into the sub-stage condenser mount, a little adjustment of the iris-diaphragm will often improve the image, as it so happens that it cuts out the rays of *lowest* aperture first.

It has been already said that the slide must be of a definite thickness, varying for each condenser, and sometimes engraved on the mount, and not more than about 20 per cent. variation from this is allowable. With immersion lenses a cover-glass of moderate thickness will do, but dry lenses are very sensitive to cover-glass corrections with this method, and cover-glasses of .17 millimetre must then be used. The film of preparation, bacterial or otherwise, should be as thin as possible, and the cover-glass pressed gently down upon it, but air-bubbles, dust, etc., must be carefully avoided, as they are very evident.

The Examination of Living Leucocytes.

Last month these columns contained a note from a correspondent in which he explained how "plasticine" (used by children for modelling) could be used for orientating opaque objects for microscopical examination. A recent communication read before the Cambridge Philosophical Society shows how incubation cells can be made with this material for the examination under the microscope of living leucocytes, and as the method would lend itself to the examination of many other minute organisms, it is worth recording here.

The author, Dr. C. Ponder, of Cambridge, calls attention to the difficulties attending the examination of living leucocytes *in situ*, namely, in the tissues of a living animal, or in the fluid from serous cavities, abscesses, or blisters, and studied in suspension in a "hanging drop." When citrated blood is centrifugalised and the blood examined as a thin preparation on a warm stage the few leucocytes found are masked by the presence of red cells. By the following method a perfectly clean preparation of a great quantity of leucocytes can be obtained direct from any blood, they can be kept alive for some time in order that their movements and other physical properties can be studied, and the manipulations are very simple. The leucocytes can be kept in free movement for some hours and their behaviour watched in relation to extraneous substances introduced in their midst, or when moving amongst a suspension of bacteria. Pathological cells, such as those obtained from a patient suffering from one of the severe anæmias, can also be observed.

The essential point is the preparation of a blood-chamber, whereby the white cells are allowed to escape from the clot and to adhere to the surface of a slide, or cover-slip, the clot being afterwards removed. To make this chamber a morsel of plasticine, half the size of a pea, is rolled out until it is as thin as the lead of a pencil and about an inch and a half long; this is then taken gently and fixed on a clean slide, so as to wall in a small chamber, with an entrance passage leading into it, thus :—

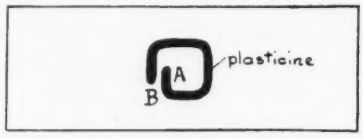

Fig. 7.

A drop of blood is allowed to fall into the chamber at A, a cover-slip is super-imposed and gently pressed down with a glass slide, so that the plasticine is flattened, blood and air are driven out of the passage B, which must be kept patent, so that the chamber itself remains completely filled with an even layer of blood, thus :—

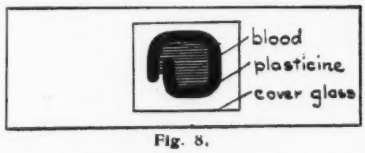

Fig. 8.

This needs a little practice, but a small air-bubble in the chamber usually does no harm. The chamber is now incubated, at about blood temperature, for any length of time from ten minutes to three or four hours, according to requirements.

The following method obviates the use of an incubator. A warm stage is prepared under a microscope by means of a copper strip, one end of which, resting on the microscope stage, is kept at blood temperature (the melting point of a fragment of cocoa butter can be used as a rough indicator) when the other end is heated by a very small flame; on the end above the flame, a flat white dish, filled with normal (.75 per cent.) saline solution, is placed, at a point on the copper (easily found by experiment) where the saline solution also keeps warm at a temperature of 38° C., or a little below. The whole slide on which the chamber has been prepared is immersed in a dish of saline, at blood temperature, and so incubated for at least ten minutes.

During the period of incubation the blood clots and the leucocytes escape and adhere firmly to the surface of the slide and cover-slip, which form the glass floor and roof of the blood-chamber; it is now only necessary to clean away the clot, which is done by lifting the cover-slip while under the surface of the warm saline solution with the point of a knife or needle, and scraping away from the slide what remains of the clot and plasticine. The slide is now well washed in the warm saline solution until all free red cells have been rinsed away, as evidenced by the disappearance of any red colour, and on holding up the slide to the light a grey adherent film can be seen, consisting entirely of leucocytes adhering to the surface of the slide.

For a temporary preparation it is sufficient now merely to remove the slide from the warm saline bath, to impose a cover-slip (taking care that plenty of saline lies beneath it), and to examine on the warm stage under the microscope. If the preparation is to be kept some time, or some other fluid, such as serum containing bacteria, is to be brought in contact with it, a new plasticine chamber, as before, but with thinner walls, must be constructed on the cover-slip, filled with a large drop of the required fluid, and the slide bearing the leucocytes pressed down upon it. Or a slide may be treated in the same way and the original cover-slip,

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bearing leucocytes, may be pressed down upon it. In one case the leucocytes will be on the floor, and in the other case as a hanging-drop upon the cover of the chamber.

The leucocytes can thus be examined for some hours in the primary chamber (the blood sealing the narrow entrance and preventing evaporation) whilst the preparation is kept in an incubator; they can be cleaned, fixed, and stained, and their position with regard to a foreign body noted; or they can be incubated for ten minutes only, transferred to a second chamber, and their movements and inter-actions with foreign substances observed.

The temperature is important, and should be near that of the blood; if much below, the leucocytes become circular and are apt to be washed off; if much above, the leucocytes become disintegrated and disappear. The leucocytes continue their movements for about three or four hours in the primary chamber, and about an hour in the secondary.

The Structure of the Eye Surface, and the Sexual Differences of the Eyes in Diptera.

Mr. W. Wesché's paper in the Journal of the Quekett Microscopical Club merits a more extended notice than we were able to give it in noticing the Journal in August (see "KNOWLEDGE," p. 319). Beginning with the observation that the eyes of the male insect are, in the majority of cases, as is well known, larger than those of the female, and that this difference is generally accepted as a secondary sexual character, the greater amount of eye-surface giving room for a greater number of facets, and thus increasing the power of vision to enable the insect more readily to find his mate, Mr. Wesché alludes to the extreme development of the eye in many flies, as in the Pipunculidæ. In this case the head of the male is almost entirely occupied by the compound eyes, and the female has acquired only a lesser amount of the same development. In the Cyrtidæ, however, the female has arrived at an equally extreme state of development with the male, and there are cases where the female has passed the male in this respect. Moreover, there are multitudes of species and genera where no difference exists, the eyes of both sexes being widely and equally separated, as in many of the Mycetophilidæ, Chironomyidæ, Tipulidæ, and Muscidæ.

There are also other differences besides size, as in the Bibionidæ, where the eye is divided by an obvious structure into an upper and a lower portion, or the facets may be of different size, those on the upper part and the front of the head being considerably larger than those on the lower part. In the Diopsidæ, a family of the Muscidæ, the eyes are placed on long stalks which project from the head, and finally the eyes may be more or less pubescent, a condition which, though often common to both sexes, is in many instances a sexual character, as in *Bibio*, where the male has remarkably long hairs on the eyes, while those of the female are bare, or only have a few scattered, exceedingly minute, hairs.

A microscopic examination of the eyes, in preparations properly cleared, shows a marked difference in the structure, by which all species of Diptera can be divided into two groups. In the first a markedly chitinous plate is pierced by the facets, or lenses; this is found in varying degrees of degeneration through an immense number of forms, the partial absence of the opaque structure increasing the light-absorbing capabilities. In the second group the chitinous plate and all opaque structures have disappeared.

Mr. Wesché proceeds to give a number of observations made from the point of view of the foregoing differences, and upon these he founds the following conclusions:—The highly chitinised plate, pierced with circular apertures for the lenses, is the most primitive form. As we ascend in development the facets begin to be hexagonal and there is much less opaque chitin, until finally, in specialised insects like the Blow-fly (*Calliphora*), the opaque structure has quite disappeared, permitting all the rays of light to enter the eye. One very remarkable eye shows these stages in transition; this is the eye of a male, the female retaining the more archaic type. The observations were made upon about forty-two families and a number of genera, and the author raises several interesting points, some of which have been brought forward before, especially as to the part played by the larger facets, whether they are simply an enlargement of space—a spreading out of the lenses to take up the larger surface of the eye of the male, a suggestion which is negatived by the fact that other insects have eyes of equal size, but covered with uniform facets, and without sexual difference—or whether they are modified to give the male both long and short sight, that is to say, to make up for the absence of accommodation and to enable the insect to see objects both near and far off. Or do the smaller lenses afford more powerful magnification, possibly a means of discrimination, so that the true species is mated with? Mr. Wesché suggests that the double eye might have arisen as a compensation for the failure of some other sense, such as the olfactory pits on the antennæ, or the sense-organs that are sometimes found on the male genitalia.

Mr. Wesché discusses the advantages of stalked or projecting eyes, as giving greater range of vision, and carried out some interesting optical experiments to determine the reason for pubescent appendages, which gave negative results, so that he concludes that pubescence is merely protective.

The methods of preparation are very simple. Mr. Wesché says that these structures are best seen in preparations cleared in caustic potash and mounted without pressure, but they can be recognised in those mounted with pressure, although in many cases high powers will be necessary to show the pubescence and the shape of the facets. In certain cases the head may be cleared in caustic potash and the eyes dissected out, and flattened (and consequently fractured) on the slip.

Notes and Queries.

New Catalogue.—Messrs. Flatters and Garnett, of Manchester, have just issued a new edition of their catalogue of microscope slides (price 3d.), which will well repay perusal. The classification is carried out in an orderly manner, which will falicitate reference, and many of the slides are arranged in sets with special reference to their use for educational purposes. Amongst these may be mentioned sections of *Anodonta*, the fresh-water mussel, and *Astacus*, the fresh-water cray-fish, both a common subject for study in our biological laboratories, a set of sections of the frog ("that martyr to science"), sections representing human and animal histology and pathology, an excellent set of 48 slides, representing elementary botany, sold in a box, with a book of explanatory diagrams, at 22s., and a very complete list of slides representing *Materia medica*. Amongst the more technical slides I notice a set of 28 sections of commercial timbers which I do not think I have seen elsewhere, a series of starches, and a series each of cottons and of wools from various localities, and of paper-making materials. There are also sets of rock sections suitable for students. All the slides are sold at very moderate prices.

[Communications and inquries on Microscopical matters should be addressed to F. Shillington Scales, "Redcourt," Adams Road, Cambridge. Correspondents are requested not to send specimens to be named.]

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The Face of the Sky for October.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 6.1 and sets at 5.38; on the 31st he rises at 6.52 and sets at 4.34. Sunspots and faculæ may usually be seen on the disc, though of late the spots have been rather small. The granular structure of the surface can be particularly well seen on foggy mornings, as the atmosphere is quiet and the image steady. The positions of the Sun's axis, centre of the disc, and heliographic longitude of the centre are given in the following table:—

Date.	Axis inclined from N. point.	Centre N. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
Oct. 3 ..	26° 15′E	6° 34′	178° 26′
,, 8 ..	26° 25′E	6° 16′	112° 28′
,, 13 ..	26° 25′E	5° 56′	46° 30′
,, 18 ..	26° 13′E	5° 33′	340° 33′
,, 23 ..	25° 50′E	5° 8′	274° 37′
,, 28 ..	25° 15′E	4° 40′	208° 40′

THE MOON:—

Date.	Phases.	H. M.
Oct. 6..	☾ Last Quarter	6 44 a.m.
,, 14..	● New Moon	8 13 a.m.
,, 22..	☽ First Quarter	7 4 a.m.
,, 28..	○ Full Moon	10 7 p.m.

OCCULTATIONS.—The following table gives particulars of the principal occultations visible from Greenwich:—

Date.	Star's Name.	Magnitude.	Disappearance.		Reappearance.	
			Mean Time.	Angle from N. point. E.	Mean Time.	Angle from N point. E.
			P.M.		P.M.	
Oct. 1	38 Arietis ..	5·2	8.25	72°	9 20	234°
					A.M.	
,, 6	κ Geminorum	3·7	11.59	37°	12.34	321°
					P.M.	
,, 30	ω^1 Tauri ..	5·8	5.51	66°	6.40	254°
,, 30	ω^2 Tauri ..	4·6	9.31	2°	9.57	311°

THE PLANETS.—Mercury (Oct. 1, R.A. $13^h\ 37^m$; Dec. S. 14° 0′. Oct. 31, R.A. $13^h\ 15^m$; Dec. S. 5° 38′) is in inferior conjunction with the Sun on the 12th, but is a morning star in Virgo towards the end of the month. The planet is at greatest Westerly elongation on the 28th when he rises at 4.56 a.m., or $1^h\ 50^m$ in advance of the Sun.

Venus (Oct. 1, R.A. $14^h\ 58^m$; Dec. S. 18° 7′. Oct. 31, R.A. $17^h\ 25^m$; Dec. S. 25° 53′) is an evening star in Libra and Scorpio, setting at 6.28 p.m. on the 15th. In consequence of the low altitude, the planet is not well placed for observation, as she sets about 80 minutes after the Sun. As seen in the telescope the disc appears gibbous, about 0·7 being illuminated; the apparent diameter is 16″.

Mars (Oct. 1, R.A. $0^h\ 2^m$; Dec. S. 4° 36′. Oct. 31, R.A. $23^h\ 48^m$; Dec. S. 3° 41′) is available for observation from sunset till early morning. On account of the planet's brightness and ruddy colour he forms the most conspicuous object in the evening sky looking South-East. On the 15th the planet is on the meridian at 10.15 p.m., and being near the equator he is very favourably placed for observation. During the early part of the month the region of the Solis Lacus is visible in the evenings, whilst the region of the Syrtis Major becomes visible towards the end of the month. The latitude of the centre is −22°, hence the Southern hemisphere is inclined towards the Earth and the South Polar Cap is in the best position for observation. The Snow Cap appears rather small but distinct as observed with an eyepiece magnifying about 250. The apparent diameter of the planet is 22″, and some of the principal markings, *e.g.*, those given above, are discernible in telescopes of moderate aperture when the seeing is good and the atmosphere steady.

Jupiter (Oct. 1, R.A. $11^h\ 54^m$; Dec. N. 1° 53′. Oct. 31, R.A. $12^h\ 16^m$; Dec. S. 0° 44′) is visible for a short time in the early morning, rising at 4.24 a.m. on the 15th, or two hours in advance of the Sun.

Saturn (Oct. 1, R.A. $1^h\ 21^m$; Dec. N. 5° 31′. Oct. 31, R.A. $1^h\ 12^m$; Dec. N. 4° 39′) is very favourably placed for observation, since he is in opposition to the Sun on the 13th, and visible throughout the whole night. The planet forms a conspicuous object in the sky, being situated about one hour East of Mars, where he may be observed shining as a bright star free from scintillation, but with a peculiar lustre which has given it the name of the Leaden Planet. The telescopic view of the planet with his rings is superb, and even when other objects are difficult to define, Saturn exhibits crisp detail, well repaying observation. The ring is visible in quite small telescopes, such as an ordinary good deer-stalker, with a high power eyepiece, and in a good 3-inch telescope the ring is visible with a power of about 50, and the belts on the planet's surface with a power of about 80. The diameter of the outer major and minor axes of the ring system are respectively 46″ and 9″, so that the ring appears fairly open, being inclined to our line of vision an angle of 12°, the Southern surface being visible.

Uranus (Oct. 15, R.A. $19^h\ 15^m$; Dec. S. 22° 48′) remains in Sagittarius, but is not very favourably situated for observation, being low down and setting soon after 10.30 p.m. at the beginning of the month, and at 8.30 p.m. at the end of the month. The planet is situated about 2° S.E. of the star ξ^2 Sagittarii.

Neptune (Oct. 15, R.A. $7^h\ 23^m$; Dec. N. 21° 22′) rises shortly after 10 p.m. and crosses the meridian at 5.45 a.m. at the middle of the month. The planet is situated about half a degree South-East of the star δ Geminorum.

METEORS.—The principal meteor shower during the month is that having its radiant point near ν Orionis, and hence known as the Orionids. The maximum is from the 18th to the 20th, and the meteors are described as swift with streaks. The radiant point is in R.A. $6^h\ 8^m$, Dec. N. 15°.

Algol presents conveniently observable minima on the 8th at 10.41 p.m.; the 11th at 7.29 p.m., and the 31st at 9.12 p.m.

TELESCOPIC OBJECTS:—

DOUBLE STARS.—γ Arietis $1^h\ 48^m$, N. 18° 48′, mags. 4·2, 4·4; separation, 8″·8. Easy double, power 30; notable as being the first double star observed telescopically.

γ Andromedæ $1^h\ 58^m$, N. 41° 51′, mags. 2·1, 4·9; separation 10″. The brighter component is intensely yellow, whilst the other is greenish blue. The fainter star is remarkable for being a binary, the components of which are now less than 1″ apart.

NEBULÆ.—Nebula in Andromeda, easily visible to the naked eye, and readily found by referring to the stars β and ν Andromedæ. Seen with a three or four inch telescope, it appears to be an extended oval, which is in reality composed of spiral streams of nebulous matter.

(32 M.) Nebula close to the great Andromeda nebula, and situated about 2° to the South. It is fairly round, and appears somewhat like a star out of focus.